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PARANOIA.

A STUDY OF THE EVOLUTION OF SYSTEMATIZED DELUSIONS OF GRANDEUR.

From the Clinical Records of the Bloomingdale Asylum, New York.

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II.

In the number of this journal for May, 1888, the writer gave an account of the origin and development of systematized delusions of grandeur in Mr. G., at that time a patient in the Bloomingdale Asylum. He was under the immediate charge of the writer at that institution up to January, 1889, when he was transferred to the New York City Insane Asylum, on Ward's Island, where he now is.

As there have been several interesting developments in his mental disease since then, and as it is possible to present further examples of his artistic skill, it is proposed in the present paper to continue the account there given, which extended up to about March, 1888.

Before beginning an account of his mental condition during the past year, it will be proper to add some facts regarding his early history that were not known at the time the first article was written. It is stated that as a child he showed some marked peculiarities of manner, being always fond of odd and fanciful articles of dress, and this was especially the case with regard to his hats and caps, he being fond of decorating these, or of wearing something that was different from the other boys. It was always hard for him to concentrate his mind on his books, and although learning readily, he was lacking in steady application.

One or two further peculiarities of conduct during his life at Bloomingdale have been brought to notice by his attendant. His practice after each meal was to go out to smoke, remaining out often half an hour or more. On his return to the hall he had one method of procedure, from which he never varied. He first washed his hands in the bath-room; then going to the dining room, he filled a glass with water from the cooler, and holding this extended in his right hand, he would balance himself on one heel and suddenly whirl about, always to the right, and would then drink the water. The force of his turning was often sufficient to throw some of the water out of the glass.

During the summer a New York artist, who had known Mr. G. in Paris, called on him at the asylum, and through this gentleman some particulars were learned about the patient's art-life abroad. As would naturally be expected, the same characteristics were noticed by his fellow-students in Paris that have been already referred to.

He was always looked on as exceedingly bright and clever, but entirely lacking in application and in the

ability to finish his work; in fact he had become known as "the unfinished artist," a particularly apt characterization. The water-color sketches which the patient showed to this gentleman during the call were said by him privately to be of the same general character as the patient's earlier work, strong and original in conception, but lacking in refinement and delicacy of finish.

Twelve of these water-color sketches are here reproduced, some having been made during the past year, and others earlier. The odd and fantastic conceptions are sufficiently evident to need no special comment. The first one, in the upper left-hand corner, he has called PUCK'S PLEASANTRIES, then comes a FRENCH COOK and UNDINE, and last an IMP AND FROGS. This last one and the next in order, THE WEST WIND, were done previous to 1888, the remainder in 1888. The remaining three are THE DANCING FROG, a second COOK, and PLEASURE, TIME AND YOUTH. The Dancing Frog he presented to a fellow-patient, together with the following original verses:

"Hay dai! Hay dai! for the month of May,
With its flowers and flocks all blithe and gay:
When the scent of the meadow and smell of the pine,
For a perfect perfume in a union combine;
And the lambs and the lassies all skip to the lea,
To dance in the clover and sport with the bee.
'Tis a season of song and a season of cheer,
So tune up the fiddle and tap the fresh beer;
And trip to your lassies as long as ye may,
For youth is for pleasure, so let us be gay."

The coloring in the last sketch, PLEASURE, TIME AND YOUTH, is particularly good, and the whole makes one of the best things that he has done. It will be seen that it is allegorical, as is most of his work. Pleasure, in the shape of a woman, is leading on the youth, who holds a wine-glass in his left hand and a bottle in his

right, while behind stalks Time, endeavoring to attract Youth's attention to the fast-flowing sands in the hour-glass.

The legend attached to this is a good example of one of Mr. G.'s numerous puns; it reads, *Life's fitful Fille-vers.* The *Fille* refers of course to the maiden in the sketch, and if the *fille* is spoken rapidly with the French pronunciation, we get *Life's fitful Fevers!*

Since the appearance of the first article on Mr. G. the writer has often been asked if, with the marked talent shown by the patient in those sketches, and which is equally well shown in these, it would not be possible to induce him to do some regular work. All attempts, however, to bring this about have been without result. The artist referred to above told him that he could furnish him with work if he would only make the attempt to do it, but the patient's reply, as on all former occasions when the subject was brought up, was that "The spirit does not move me." Being passionately fond of the theatre, he has often been offered a theatre-ticket if he would only make some small sketch in return, but he prefers to lose the enjoyment of an evening's pleasure rather than to try to force "the spirit." Only once did he ever make a sketch under compulsion, as it were, when he made for the writer, in exchange for a theatre-ticket, the beautiful water-color sketch that serves as a frontispiece for this article, and which he called PARADISE AND THE PERI, his conception being taken from Moore's well-known poem, the sketch representing the first two lines:

> "One morn a Peri, at the gate
> Of Eden stood, disconsolate."

Through the kindness of his family and of one of his friends it is possible to present here representations

of three of his early works, begun and finished before his mental disease developed.

The two upper ones in the group of three are water colors, both harmonious in design and execution, the larger one being especially pleasing. The lower one is a landscape in oil, and unfortunately is not a subject that can well be represented by a photograph, but the original is a very meritorious piece of work, and has been highly spoken of by one of the first landscape painters in America.

How great a change has been brought about by his mental disease can in no way be better appreciated than by comparing the quiet and restrained beauty of these works with the group of five water-color sketches at the end of the article. In the center is the hideous witch. In the upper left-hand corner PUCK is disporting himself with a frog on a toadstool, while opposite is SYCORAX, the mother of Caliban. In the lower right-hand corner is another WITCH, and on the other THE VAMPIRE looks out from her cave of darkness, a human skull lying before her, and blood dripping over the edge of the rock.

Mr. G.'s chief occupation during the summer and autumn of 1888 was the writing of a book of 200 quarto pages, with the following title-page:

THREADS OF THOUGHT.

GLEANINGS GATHERED FROM THE GREEK GODS.
SIFTINGS FROM THE SANDS OF THE SIGHING SEA.
FROM BEER-SHEBA TO DAN AND ON.
FROM THE DEAD SEA TO DAYLIGHT.
ALPHA AND OMEGA.
Fret not thy Guise-ard.

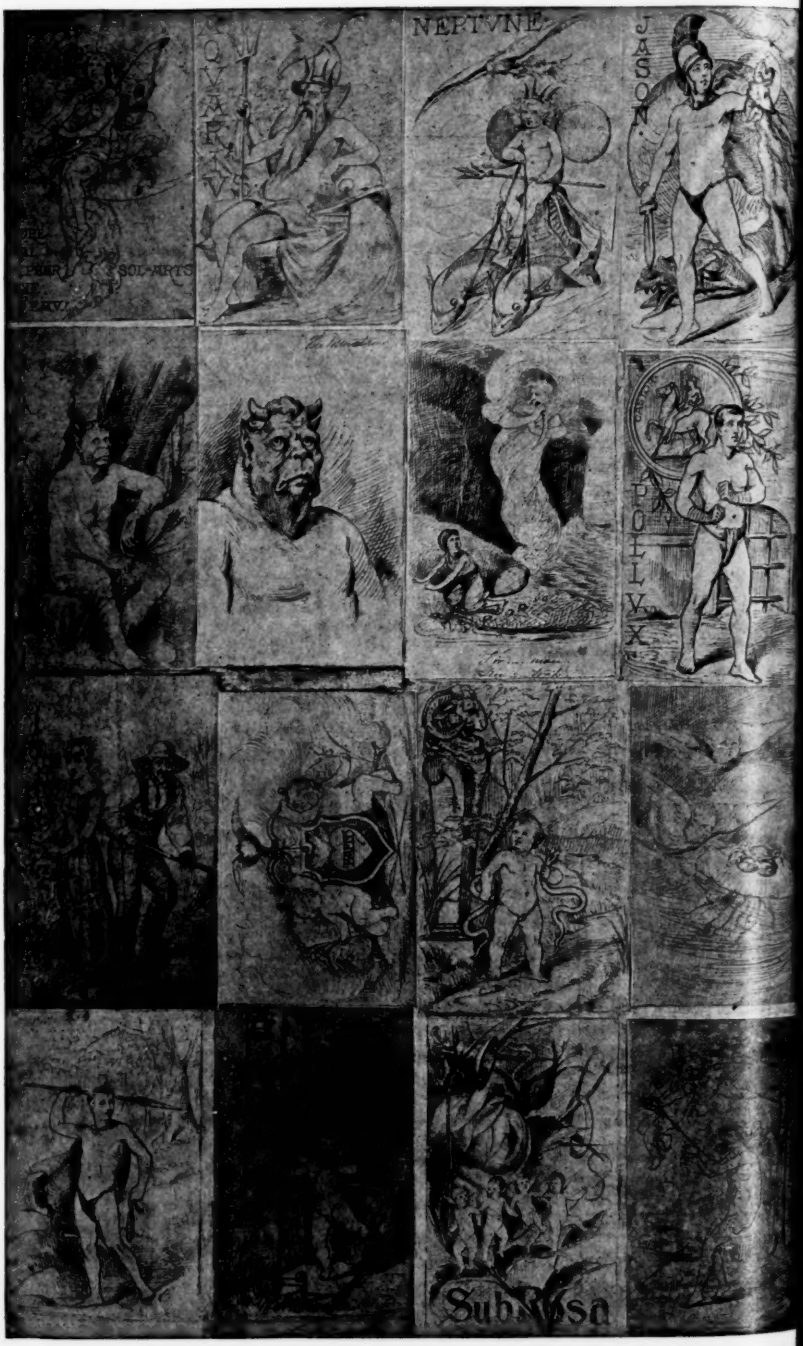
"The mills of the gods grind slowly, but they grind exceeding fine."
"Her 'prentice hand she tried on man, and then she made the lassies, O."
"Whom the gods wish to destroy they first make mad."

Opposite the title-page is a pen-and-ink sketch serving as a frontispiece, representing the GODDESS OF MUSIC sitting on the crescent moon, playing on the harp. The legend attached, which at first sight appears to be an inscription in French, is in reality a pun on the musical scale, *do, re, me, fa, sol, la, se, do.*

He divided the book into twelve parts, one for each month in the year, and at the beginning of each month is given the mythological sign of the zodiac, the member of the body for that month, the tribe of Israel to which the month is dedicated, the name *Christ Jesus*, one of the Apostles, one of the Holy Stones, one of the days of the week, and finally, the name of one of the ancient churches. Following this is a description of the mythological person to whom the month is sacred, after which comes a description of some Greek or Roman divinity, from some dictionary of antiquities. On the page opposite to this description is inserted before each month a pen-and-ink drawing of the mythological hero or heroine that the ancients associated with the month.

Opposite January is Aquarius, and the arrangement of the descriptive matter for this month will serve as a general example of the arrangement of all the other months:

"Jove. Zodiac. Aquarius. The Waterman.
A. Member. Legs. Les jambes. Le gambe.
Month. January. In honor of the god Janus.
Tribe. Simeon. Hearing with acceptance.
Christ Jesus.
Apostle Matthew. Gift of Jehovah.
Gem. Jasper.
Day. Monday, sacred to the moon.
M. Church. Ephesus.


QVARTVS
NEPTVNE
IASON
POLLVX
Sub Rosa

Y. Janus. Represented with two heads, and called therefrom Biceps—the keeper of all gates—also called Matutinus, as opener of the day; represented with a key in his left hand and a staff in his right. He was also called Quirinus because presiding over war. Clusius and Patulcius as 'shutter' and 'opener' of gates. He was called Curiatius because he was charged with the care of the world. Janus and Jana the *solar* and lunar deities, derived from Oriental names of Divinity, Jah, Jao, Jovis, whence Jom or Yum, 'the day.' Quirinus is derived from the Sabine word curis, 'a spear.' When represented four-headed he was denominated Quadrifraris, and is identical in appearance with the Brahma of India. He was like Hermes, the guide of souls from Purgatory to Heaven."

The illustrations preceding the twelve months are as follows: Aquarius opposite January; Neptune, February; Jason, March; Taurus, April; Pollux, May; Infant Hercules, June; Achilles (with the spear), July; Pandora, August; Libra, September; Aegyptus, October; Apollo (drawing the bow), November; Bacchante before Pan, December.

Aegyptus is represented by two drawings, the seated Egyptian figure and the sacred bull. A long description is given of each of these personages, the circumstances of their birth and parentage being given, together with their adventures, and the rites with which the divinities were worshipped.

After these mythological characters have been described, Mr. G. has set down in each of the twelve

divisions of the book his own thoughts on different matters, mostly religious, and quotations from the Bible, short poems and extracts from poems. Proverbs, old saws and original verses are mingled freely together without any order or coherence. His remarks on religious subjects are often strikingly forcible and original, and sometimes remind one of the impassioned utterances of a revivalist preacher, and they are not seldom poetic in beauty and expression.

The description of Janus already given is immediately followed by these quotations:

> "Fortitude is better than biceps for building.
> 'He who tholes conquers.' Allen Ramsay.
> 'It's good to be sib to siller, but more siller
> When you're sib to '*The King*.'"

And these are followed by a song from "Love's Labour's Lost," after which come various remarks on religious subjects:

"Man that is of woman born is of few days and full of sorrows. He learns to lisp words the meaning of which he knoweth not. He learns the alphabet and how to form words. But all this learning to him makes him like to the pig fed upon the pod of the pea; a higher intelligence first eats the fruit of the soil and then, having fed him upon the husk, eats him. And so the greater 'Good' absorbs and refines the lesser lights, so a penny dip may eventually become a particle of the great and glorious 'orb of day.' In the beginning was the Word, and the Word was with God, and the Word was God. The same was in the beginning with God.—St. Luke, 1st c., 1 and 2 v.

"The infant at its birth is simply the jar (Jah) in which is planted the holy seed, or germ of the Word, which is to grow and flourish, according to the love and devotion bestowed upon it by its parents. Until the

child is able to express a thought of its own, it is no more than the journal in the which you write the occurrences of your daily life, and which must be opened and like a flower allowed to bloom in order to find color and expression. Few people appreciate the mighty magic of the Word, or realize that the thoughts we think (which are nothing more than the combinations of the Word of God) generate either manna or rank poison in the hidden tissues of the body, and that we transmit this good or evil in a greater or less degree to whatever we come in contact with, through limb or lung. Like seeks like all the world over. Consequently, if you are harboring evil in your heart you will not only garner what you gather, but the evils of your neighbor will fly to you, if your power of evil outweighs his; just as the needle is attracted by the stronger magnet.

"Man is the only creature to whom is allotted the power of selection or choice; the dog must always be a dog, until evolution passes his spirit into some higher form, but man may have the semblance of the god, and the heart and habits of the beast, all through his own choice and a failure to honor the commands of God. The body of the beast cannot hold that which is God-like; it would burn it up, for our God (the God of Love) is a consuming fire. If we dishonor the temple of God, our mortal bodies, by gathering wrath and holding it, we shall be driven out into the abode of some beast (as was Nebuchadnezzar) until such time as our sin shall have been purged away. The teachings of Pythagoras were just as much inspired by God as those of a broader doctrine delivered by Paul. But Pythagoras drove the spirits of erring mortals back into the beast and then taught us hope of redemption, while the teachings of

Christ constantly raise the soul of man from the groveling worm to the heights of heaven. Forego wrath, let go displeasure. Vengeance is mine, I will repay, saith the Lord. Wrath and anger are but the outgrowth of a longing for revenge; they are alchemists concocting vengeance in the secret chambers of the heart and liver. Turn them out, let them go, they are thieves and robbers. Better a dinner of herbs where love is, than a stalled ox and hatred therewith. If evil thoughts come into your heart don't give them house-room, purge them out, and above all give them no utterance, for if you do it is your endorsement to a note of hand signed by your enemy, and ten to one a note he will leave you to pay. Never call another a liar; make them, if you can, put their statements in black and white over their own signature, then they will have certified to their own lie; let you add a little of the grace of God thereto, and a very good purge and cleanser may be evolved therefrom, and society thereby relieved of much filth and ugliness.

"The man who keeps cool
Needs no compass or rule,
For his measure or guide, when he builds;
For his God in the sky,
Has him close to his eye,
And turns back the foe, when He wills.

* * * * * * * *

"The name you bear is one of God's names; you received it through baptism, at the hand of God's servant, one of his ministers; in like manner so did your parents before you. It is your bounden duty as a Christian to learn to know the full meaning of this God-given name, and then to live up to it. If we learn to listen to the quiet spirit that ever dwells *within* the house (the one that sings in our heart when we are gay and glad and thankful) and follow its teachings,

we shall ever find the Temple of God filled with His presence, the Shechinah[1] that veiled the mercy-seat of old; and the quick spirit of discord, so prone to argument and discussion, who is an eavesdropper and a listener at corners, and who is ever ready to fly upon the tip of our tongue and hail a storm of words, he will fly away to some more congenial habitation.

"Merlin built for King Arthur a royal habitation, filled with all the luxury and elegance that wealth or art could furnish or devise; and on the castle's peak, spreading its wings to heaven's blue expanse, he placed an angel of burnished gold, symbol of the peace and love that should reign within the palace walls. To this edifice of beauty thronged the knights of King Arthur's Round Table, to joust and tourney; and merry feast and woman's smiles were not sufficient to keep them contented and happy. The devil of unrest, envy, and worldly ambition entered their hearts and showered upon them the seeds of lust to suffocation. They parted, and sought in devious ways to find the Holy Grail, not knowing in that dark and stormy day that the Kingdom of God is in man's heart, and that His hidden treasures are always to be found there. The warriors of the Table Round one by one crumbled into the dust from whence they came, the golden angel raised its pinions and soared from the palace peak; grim Time at last swept away all traces of a king's abode, and nought remains to us but a legend of knights who came to grief and the grave through lack of honor and lechery. Mark you, my friend, your name, and your body that bears it, comprise your palace of Truth, above which God has placed the

[1] See Mr. G.'s water-color sketch of SHECHINAH, in the first article, Am. Journal of Psych. I, 475, and page 16 of the reprints.

guardian Angel of Peace and Love; see that you wander not from 'Home'; seek not the laughter of strangers; be content with the arrows in your quiver, or you, too, may meet with the same disastrous end as the knights of the Table Round.

* * * * * * * *

"Water contains just the same subtle qualities to-day as it did when Christ changed the water into wine at the marriage of Cana. But we should be careful how we use it, for if you mix with it other than good thoughts and thankfulness, it will produce no wine in your jar, but, on the contrary, something very much resembling poison in its action. It is not what we eat and drink that hurts us, but what we mix with it from our own internal infernal economy.

"'Spare the rod and spoil the child' is not to be taken literally, for the teaching to be conveyed lies deeper than the surface of the line. The child is the recipient of a reasoning faculty which, if you cultivate by argument and teaching, will spoil the child, in one sense, by developing that which is manly in its nature. We beat an animal because it has no power of argument or speech, but even in this case moral force is better than blows; for the spirit that animates the brute and causes it to live is the same that pulsates in the heart of the babe, and may be reached in the same way, although we hear no audible response to our admonitions. Blows to brute or babe are always an evidence of lack of patience and want of wit. Striking a child for a misdemeanor is as sensible as beating your own head against the wall for some error committed; you blunt the very faculties you wish to build up and improve when you use brute force instead of reasoning and logic. Furthermore, you alienate the nature that has been given you to

love and cherish; you repel it instead of drawing it towards the light and warmth of your own intelligence; you not only extinguish its fire, but you are destroying your own as well, for the child is given us that he may replenish the holy fire upon our hearthstones as it burns low.

"Brutality drives the angel from the door and places a fiend in its stead. Brutality is a boomerang that recedes upon him who uses it as a weapon with redoubled force. Wisdom's ways are ways of pleasantness, and all her paths are peace.

"Prayer to God is always answered; we are not always aware of the fact; when the answer comes to us we fail to recognize it because we have made ourselves spiritually blind. We cultivate our spiritual nature to such a degree that the soul becomes like a diamond in a bladder; its beauties are hidden because it is shut out from the light of that great power called God that made it and its wonders. Man, in the course of his life, is constantly brushing past the Angel without recognition, simply because he is ever plowing the fecund earth with his nose, like any mole. Look neither up nor down, but straight ahead, fair into the eyes of your fellow-creatures; God's universe is there and His kingdom infinite; His messengers respond quicker than thought; His mandates pass swifter than the flight of bird. His eyes are everywhere beholding the evil and the good. 'The wish is father to the thought'; therefore be careful that your thoughts assume not the garb of the Destroyer, for you must e'en play the part if you don the robe; you must fill your role or quit the scene."

Here follows a page from *The Light of Asia* and several old sayings, after which is the following on Good Thoughts:

"Good thoughts breed other good thoughts; as the snowball rolls it gathers its like and grows. There is no gift so gladdening as fair speech; other bounties that we lavish upon each other fade away and are lost and forgotten sometimes, but the music of kind words comes ever echoing through the deep defiles of the past with all the freshness and joy of the day that ushered in their birth. Oh, blessed God-gift of speech!

"The Bible is Life's great mentor, to which we should go for confirmation of our beliefs and acts; it is the standard by which man is to acquire the art of right thinking and right doing. '*Ars longa, vita brevis.*' The Old Testament is a history of the natural man living under the influence of a God whose personality is undefinable and beyond his comprehension; whose presence is only realized through his manifestations in Nature. The New Testament is the development of a new birth in this natural product of the earth and its forces, in which the mind of man is ushered into a new light and made to realize that God walks in the hearts of men and in time transforms them into a perfect image of himself. The natural man resists this new birth just as the elders of the church resisted Christ and finally crucified Him; the earthly and spiritual natures cannot exist together—the one crowds the other out—for one is a destroyer, a consumer, while the other is always a builder. The spiritual nature in man never feeds upon itself, as the physical nature often does, but is constantly conceiving new combinations, evolving new thoughts in the great storehouse of the mind, and sending them out on errands of love and mercy. The spiritual part of man is like the widow's cruse; draw from it as you will, it never empties, for it is a portion of God, and consequently inexhaustible."

The above is all from what he had gathered together under January, there being rather more religious matter than in the following months.

February contains much less that is of interest, the first part of the month being taken up with quotations from the Bible, Shakespeare, and a long account of Neptune. Later on we find the following:

"He who goes through life with his nose constantly in the ground may become intimately acquainted with the worth and ways of bugs and sods; but he will miss the great glories of the universe and the mysteries of the brotherhood of man. Head erect, eyes to the fore, and remember God walks in the secrets of the heart.

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"All the Greek and Roman deities are but different phases of that Great Power which we now worship as God. And these various forms of worship were given to man that the spiritual child might climb to the realization of the Infinite by easy grades, and not be startled into frenzy, madness and death by the glory and magnitude of Him who guides the universe. The ancients were great and successful in proportion to their faith in their gods and the integrity of their devotion. Just as men to-day make a god of money and bow to the golden calf, are the most successful in gathering money, who are the most sincerely devoted to their idol. But all the gold in creation will not save a man from the hands of death, or buy back his soul when once he has pledged it to an idol of gold. Gold is a good means to an end, but should never be mistaken and worshipped as the end-all and be-all of life. All the men in history from time immemorial who have tried to lift themselves into power and thereby gain happiness by a golden lever have been signal failures.

"The force of love is so great, so strong, so intense, that if a man were to fill his store-houses with it at one fell swoop, before preparation had been made for such commodity, it would burn him and all his belongings up. *His* ministers are a flame of fire.

"Richelieu said to Baridas, 'Behind thee stalks the headsman.' The same might be said, with equal truth, to each one of us: for each man bears his judge with him, who condemns or justifies as the case may be. The thief, the assassin and murderer always fly the hand of justice, but they never by any chance evade their doom; they may miss the hand of man, but the hand of justice presses them closer than their own shadow. Often through the retina of the eye does conscience throw upon the ambient air the figure of the murderer's victim. A man can no more shirk the responsibility of his own misdeeds than he can shake off a fever by changing his coat."

March is devoted almost exclusively to mythology, and need not detain us. In April he has given his idea of *evolution*, and its failings as applied to man.

"The respects in which evolution as a necessary process in the natural and brute worlds does not wholly apply to man:

1. Instinct yields to conscious intelligence.
2. The struggle for existence yields to a moral law of preservation, and so is reversed.
3. Intelligence takes the place of natural selection.
4. The will comes into supremacy, and so there is a complete person. Man, instead of being wholly under force, becomes himself a force.
5. Man attains full, reflective consciousness.
6. Conscience takes the place of desire.
7. The rudimentary and instinctive virtues of the brutes become moral under will and conscience.

8. Man comes into consciousness of God.

9. Man's history is in freedom.

10. Man recognizes and realizes the spirit.

"Contrasting phenomena of evolution under necessity and evolution under freedom:

1. Man changes and tends to create his environment; achieves it largely, and so may prolong it. The brute adapted itself to environment, but had no power over it.

2. Man progresses under freedom. The brute progressed under laws and environment; man, under will and moral principles of action.

3. Man thinks reflectively, systematizes knowledge and reasons upon it; the brute does not, except in a rudimentary way.

4. Man has dominion; the brute is a subject.

5. Man worships, having become conscious of the Infinite One; the brute does not.

6. Man is the end of creation, and the final object of it; the brute is a step in the process."

In the first article a description was given of two of his religious diagrams, representing *The Sealing of the Holy Spirit*, and this he refers to in the following description of the wheat-berry; elsewhere in his book he quotes from a magazine article on the form and structure of the wheat-berry:

"The wheat-berry has seven coverings, the same as man has the seven seals of God upon his spiritual grain or soul. Sometimes the worm (called envy, hatred, and malice) perforates these coats in the first Adam, and the spirit writhes out from its temporary abode, in agony, like the wrigglings of matter strained through a colander. This is the agony of death, but when the seals are kept intact until the season of per-

fect ripeness arrives, the transition is one of perfect peace, and consequently painless. Man, in spite of the laws of nature and all that has been written or said regarding the theory of evolution, would fain skip the chrysalis stage and jump from grub to butterfly, without any prolonged period of durance-vile. Patience is a hard lesson to learn, no matter how you fix it, for man is born with the seed of the tyrant lurking somewhere, and wants to rule."

At this point is inserted the drawing of the FISHERMAN AND THE GENII, which is to illustrate a story in the Arabian Nights. It is the one under which is the inscription

"Vir . . . . man
Gin . . . . trap,"

this being another pun, the Latin *vir* meaning *man*, and *gin* a *trap*, while combined, *virgin* equals *man-trap*.

There are some original verses descriptive of this drawing, called *Nettles, etc.*, describing the terror of the fisherman on opening the old earthen coffer, to be confronted with the air-spirit.

This concludes the month of April. In the month of May, besides the usual mythological stories and Bible quotations, is the following original poem:

"Oh! Peace beyond the power of thought;
Oh! Happiness by good deeds wrought;
Oh! Sun that never quits the day;
Oh! Lillie pure as chrystal spray:

"Oh! Living mandate of our God;
Oh! Pathway that the Saints have trod;
Oh! Zephyr from the perfect blue;
Oh! Lambkin born of stainless Ewe:

"Into our chamber's holiest ground,
Find entrance meet. Let love abound.
Oh! fill Thou both our bed and board
With the full spirit of the Lord.

"Guard well the lintel and the sill,
'Gainst lurking foe and hidden ill,
And let no discords enter there,
Nor thoughts that work the soul despair.

"But firm in faith, secure in Thee,
Let worship of the Holy Three
Purge from our hearts all evils done,
And bless us with 'Thy Kingdom come.'"

This is followed by other original verses, and in these he makes the only known reference to the fact that he is confined in an asylum:

"1. Immured in a mansion made for madness,
Where naught that doth pertain to gladness,
Enters the gate or through the door,

"2. I count the hours long and dreary,
And ruminate and grow most weary:
The slack of time is such a bore.

"3. I think, perhaps if I played crazy,
This life which now seems dull and hazy,
Would change, if I my clothing tore.

"4. A jig, or fit, some caper funny,
Might add to life a little honey,
And in the heart some balsam pour.

"5. But here to sit like wart or bunion,
Or bulbous growth upon an onion,
And know the gay world never more—

"6. I'd rather rise by slow cremation,
And leave this dismal dull damnation,
By giving up this mortal corps.

"7. What! eat and sleep and then grow musty,
While all your senses clogged and rusty,
Refuse to act as heretofore?

"8. I'd rather hang upon a gibbet,
And make old bones for flies to fidget,
Than sit here till my sides were sore."

May seems particularly to have inspired him poetically, for after these verses come two more series, and he concludes the month by quoting the exquisite little

poem by Austin Dobson, *A Fancy from Fontenelle*,[1] which he has illustrated by the Maiden and the Gardener (directly under Taurus).

The succeeding picture of the series, entitled FAITH, also has an original poem given to it, but it is rather mystical and obscure. The two cherubs are intended to represent the *Gemini* of the zodiac, in some spiritual sense, in the same way that Castor and Pollux represent it physically.

June is ushered in by the picture of the INFANT HERCULES (following FAITH), and the month is mostly taken up with a description of the adventures and labors of Hercules, and is concluded by the picture of the spirits blowing on THE CRAB, the crab being the zodiacal sign for June.

ACHILLES with his spear faces July, and in this month the artist has placed the graceful little figure LA SONNETTE, Cupid ringing the bell to awaken the maiden within. This is accompanied by some verses

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[1] As illustrative of Mr. G.'s refined sense and appreciation of beauty, perhaps it may not be out of place to quote the verses here, as they were intended to accompany the drawing.

A FANCY FROM FONTENELLE.

"De mémoires de Roses: on n'a point
vu mourir le Jardinier."

The Rose in the garden slipped her bud,
And she laughed in the pride of her youthful blood;
As she thought of the Gardener standing by—
"He is old—so old! and he soon will die!"

The full Rose waxed in the warm June air,
And she spread, and spread till her heart lay bare,
And she laughed once more as she heard his tread—
"He is older now. He will soon be dead."

But the breeze of the morning blew, and found
That the leaves of the blown Rose strewed the ground,
And he came at noon, that Gardener old,
And he raked them softly under the mould.

And I wove the thing to a random rhyme,
For the Rose is Beauty; the Gardener, Time.

Austin Dobson.

SESAME
PANDORA
LIBRA
MINERVA
HERMES
BACCHVS
APOLLO
PAN
CAPRICORNUS
BEAUPRE
LE VOILE AV VENT

which are somewhat more graceful than many he writes :

"La Sonnette.

"When Love comes ringing at the bell,
And finds no maid to heed his spell,
He simply sighs and lifts his eyes,
And hies away with Alack-a-day!

"When Cupid comes on dewy wing,
What are the notes the zephyrs sing?
Come laugh and sing and greet our king,
For while we may let's make our hay.

"What says the swaying of the bell,
What are the words its tinklings tell?
Come to the lea, 'tis he, 'tis he!
The merry monarch blithe and free,
Leave bin and care and hail the heir.

"What says the Sun, when day is done?
The maids were many, the bride was one.
Who loves him little should love him long.
So rhymes the riddle to suit the song,
Come robe the king, and favors bring."

The two pictures following, Sub Rosa and the Maiden and Cupid, are inserted without any verses or explanatory notes.

The drawing Sesame is more deeply allegorical than many of the others. On the right-hand side of it he has written the names of the seven coverings of the endosperm or center of the wheat-berry, and below is the verse from the third chapter of Genesis :

"So he drove out the man ; and he placed at the east of the garden of Eden, cherubim, and a flaming sword, which turned every way, to keep the way of the tree of life."

And on the opposite page, verses from the fifth chapter of Revelation, beginning, "And I saw on the right hand of him that sat on the throne a book, written within and on the back side, sealed with seven seals. And I saw a strong angel proclaiming with a loud voice, Who is worthy to open the book, and to

loose the seals thereof? . . . . And in the midst of the elders stood a Lamb as it had been slain, having seven horns and seven eyes, which are the seven Spirits of God sent forth into all the earth."

He thus appears to connect the angel that guarded the gate of the Garden of Eden and the angel before the throne; and it is especially interesting to see the influence that the number *seven* has on his mind, as was the case with the Seven Sealings of the Holy Spirit in his religious diagrams.

Next in order comes the sketch of PANDORA, with a description of her attributes, and then several pages of description of the beliefs of the Buddhists, on which he comments:

"All these theories and beliefs relative to the great Creator are but so many pieces taken from the great mosaic of the Bible. All the existing religions in the world are simply stars in God's spiritual pyramid, the apex and key-stone of which is Christ. The Holy Bible is the point from which all beliefs radiate; it contains all that man knows or may know of that Supreme Being we call God. All the secrets that perished in the Alexandrian Library are hid between its two covers, and may be found by those who tread the path of love; but let no one with hate imbued start upon the quest, for the Holy Book is the Gate of the Garden of Eden, and He placed of old at this gate an angel with a sword of flame, to guard the ground from guilt and shame."

Reference was made in the former article to the fact that he considered himself as undergoing a probationary stage, and would in time become worthy to receive a great spiritual revelation. This is made more clear by the following:

"When the realization of the Christ first breaks in upon man's nature, it is the dawning of his spiritual day, the first gleam of the soul's sun. 'The Sun of Righteousness,' from whence we derive light and life, and around which spiritual point revolve all earthly changes until this Sun is realized in its perfect magnitude, filling space, and being one and inseparable with God. When once this truth has germinated in the heart of man, if only one thin ray of the heavenly light has penetrated to the secret recesses of his nature, its influence never leaves him; it may be obscured by the fogs and mists of doubt and clouds of earthly cares and vexations, but high above the vapors of the world rides this Great Redeemer, who is constantly drawing us imperceptibly to himself, while the fire of His love is purging and cleansing away that which is mean and perishable in our being, and fitting us to behold the full glory of His majesty, and to stand in His presence without fear and without reproach. Man cannot gaze on the physical sun without blinking, much less could stand the glory of the spiritual sun; the vision would consume him, unless he had passed through the incarnations which give one the requisite spiritual strength. God's mercies are manifold, His mysteries marvellous and unanswerable, and that which He hath begun abideth forever. Allah illa Allah!"

The sketch of LIBRA faces September, and MINERVA follows, with a description of the goddess; and the remainder of the month is mainly given up to religious subjects.

September is prefaced by AEGYPTUS, the zodiacal sign of the month, the scorpion, being seen in the circle above the seated Egyptian figure, while *Aegyptus*

the Bull follows, with an account of his worship. He comments on the Egyptian priesthood, and incidentally on *lunacy*, as follows:

"The confusion of faces, spoken of in Daniel, is the same physical phenomena that gave to the Egyptian priesthood, and that of some of the other nationalities, gods and goddesses with the heads of birds and beasts. When people worship the creature more than the creator, then comes the messenger of the gods, Mercury, and takes possession of the human body, and throws upon its surface whatever he finds reflected upon the mirror of the mind; hence diversity of aspect and consequent confusion. There is nothing hidden but shall some day see the light. This phenomenon is to-day stigmatized as 'Lunacy,' and the cunning and science of medicine generally succeeds in driving out the angel and sustaining the devil or beast, which are one and the same thing. Spiritualistic mediums are under the same influence, and usually end their days in some insane asylum, unless they change their mode of life, for they are as a rule lecherous scatter-brains, either in thought or actual practice. This is a rod by which the great good God drives men to prayer and search of Him, the Creator of all things."

November being represented by Sagittarius, The Archer, is appropriately introduced by APOLLO, shown in the act of drawing the bow, and a long description of him follows; and then comes BACCHUS and his story, and Barry Cornwall's poem *To Bacchus*. A second sketch of APOLLO, here more appropriately shown with his lyre, is followed by a poem *To Apollo*, by L. N. Torre.

December is introduced by the DANCING BACCHANTE,

instead of by CAPRICORNUS, the proper zodiacal symbol, this latter picture being placed in the middle of the month; and the story of Pan is told. A rather good comparison is here given when he says:

"Man is the social chameleon, whose mind, morals, moods, and manners are colored by the thoughts on which he dwells."

The remainder of the book is taken up with religious reflections, and these quotations may not inappropriately be closed by the following, which might not seem out of place in the writings of a more ambitious and fortunate religious teacher:

"Men complain of a continuance of bad luck because they have not prepared themselves in a way to deserve better. People cry out against Nature and Fortune because their crops fail and their children turn out bad, when the fault lies at home. Hell is just as hot and horrible as we have a mind to make it, and heaven creeps into a man's heart when the place is fit for its indwelling; it is a condition, not a locality limited by any bounds save such as are spiritual and consequently limitless. You don't have to reach to heaven or fly to it; it comes to you when you have finally won it, and it makes you a part and parcel of itself; in other words, it is the spirit of purity, the spirit of Christ dwelling in us and making man his own. Growling and grumbling at the humble trivialities of life often shuts the angel from the door—turns away God's messenger, and retards the dawn of that bright day of more perfect light, when we shall no longer see as through a glass darkly, but face to face with truth revealed in all its native loveliness."

The sketch LE VOILE AU VENT and the graceful and beautiful CUPID at the door complete the illustrations.

The mottoes on this last sketch are "Nemo me impune lacessit," which he translates, "No one wounds me with impunity," and gives it as a motto of the Scots; at the right-hand side "Beauty conquers all," representing the "Candore omnia vincit," on the left; and "Truth is mighty and will prevail."

The written matter is brought to a close by the following page:

"He laughs best who laughs last.

"T, he, some of the means equals t, he, some of the extremes.

"These are the aberrations of a fitful and fit mind.

"Let none erase, nor pen, or trace,
Upon this book of mine;
In solitude I've writ it all,
And thought upon each line;
There's much within that is my own,
And much that is divine.
So let no sacrilegious cur
Pollute the page
With blot or blur."

The three remaining illustrations at the end of the page would have found a place more appropriately in the first article, but it was not possible to give them at that time. The larger one represents a photograph of his bureau drawer, which well illustrates his passion for order and symmetry and for the regular and harmonious arrangements of lines. The order of the arrangement of these articles never varied from day to day, and was maintained with scrupulous exactness. The carved bowl, with the motto *Pro Rege in Tyrannos*, has already been described. Above this is what he called his *Chestnut*, and represents a shallow lead receptacle with a cover fitting over it, in general shape resembling a chestnut. It may be recalled that the lead was obtained by melting up tin-foil picked up on the asylum grounds. The space in the lower half

is filled with powdered orris-root, in which is placed the body of a locust.

The grace, beauty, and poetic conceptions shown in these sketches and drawings, and also in the quotations, are such that it must cause the most profound regret that such talent and originality should have been hampered in its development by a faulty physical development, and that an incurable mental disease should have clouded such a brilliant intellect.

As in the former article, it is not proposed to discuss the nature of the mental disease from which this remarkable and talented man is suffering, but merely to present as complete a record as possible of his disease. Since his transfer to Ward's Island there have been other and different developments of his artistic work, but the present article may properly end with the close of his residence at the Bloomingdale Asylum.

SOME EFFECTS OF ELECTRICALLY STIMULATING GANGLION CELLS.[1]

C. F. HODGE.

The experiments about to be described were made in the Psycho-physical Laboratory of the Johns Hopkins University during the winter of 1887–8 and fall and winter of 1888. I desire at the outset to make the fullest acknowledgment of my indebtedness to Dr. H. H. Donaldson, under whose guidance the work has been carried on, and to whom much of its success is due.

Theory and Purpose of the Investigation.

The theory that underlies physiology is that all function is due to chemical changes taking place within the living organism; and, further, that the functional activity of a specialized tissue depends primarily upon these changes in its individual cells. That these changes may reach a magnitude easily demonstrable with the microscope has been proved, as every one knows, for the cells of certain glands. My present purpose is to ascertain to what extent and by what methods changes due to the functional activity of ganglion cells may be in like manner demonstrated.

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[1] Dissertation submitted to the Board of University Studies, Johns Hopkins University, for the degree of Doctor of Philosophy, April, 1889.

A preliminary communication upon this work appeared in the American Journal of Psychology for May, 1888.

Historical.

The great amount of work devoted to the morphology of the nerve cell is in the main aside from the problem in hand. It need be here referred to simply as it furnishes the structural mechanism necessary for a conception of the physiological working of the ganglion cell. This is furnished by Schultze,[1] to whom is justly ascribed the credit of demonstrating the fibrillar and granular structure of nerve cells. Later methods have, however, demonstrated this more sharply; and for the best of these we are chiefly indebted to Professor Kupffer[2] and Boveri.[3] This method consists, essentially, of hardening a perfectly fresh nerve in osmic acid and subsequently staining with acid fuchsin. Seen in section after this treatment, the medullary sheath appears black, and, what is of most interest here, the axis cylinder shows fine red fibrils in a finely granular matrix. The ganglion cell by this method is found to consist, beside nucleus and nucleolus, of a dense tangle of fibrils, unquestionably the same as those occurring in the axis cylinder, with an irregularly granular material filling the spaces between the fibrils. We are thus given at least the two things necessary for a nerve mechanism: the fibril to conduct, and, in close connection with this, some sort of substance, changes in which may serve to originate or modify the nerve impulse.

Of great significance to the problem in hand is such work as Heidenhain and Langley have done on the

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[1] General characters of the structures composing the nervous system. Max Schultze, Stricker's Manual of Histology, p. 116.

[2] Ueber den Axencylinder markhaltiger Nervenfasern. Prof. C. Kupffer. (Sitzgb. d. math. phys. Klasse d. k. bayr. Akad. d. Wissensch. 1883, H. 3.)

[3] Beiträge zur Kenntniss der Nervenfasern. Theodor Boveri, Munich, 1885.

histology of resting and secreting glands. There are evident points of similarity between the active processes of gland and ganglion cells. There seem also to be points of difference which make it difficult at present to homologize the processes of the two. At any rate this is not the place to discuss that phase of the subject.

The pathology of nerve tissue is, of course, closely related to its functional activity. The subject, however, is so large, and so little of it bears directly upon the point in hand, that any general discussion of the pathological literature may be best relegated to a subsequent chapter. Two papers may be briefly referred to as throwing some light upon the results of my own experiments.

In 1878, Angelucci[1] made a study of the histological changes in spinal ganglion cells of four cases of nervous disease, one of chronic, two of acute myelitis, and one case of paralytic insanity. I will only note that in the series of degenerative changes described by him, the nucleus plays an important part. It early loses its rounded outline, becoming "stelliforme," shrinks up and disappears, leaving the cell a lump of pigment and fat.

More nearly physiological is some work of Rosenbach[2] upon histological changes in the ganglion cell due to hunger. Rosenbach worked upon dogs. His method consisted in depriving the animals of food for different lengths of time. At the expiration of the desired period, or upon the death of the animal, sec-

[1] Osservazioni sulle alterazioni dei gangli intervertebrali in alcune malattie della midolla. Arnaldo Angelucci. Atti della R. Accademia de Lincei, Serie III^{a} V^{e} 2^{o}. Rome, 1878.

[2] Das Nervensystem im Hungerzustande. P. Rosenbach. Centralblatt für Nervenheilkunde, 1884.

tions were made of the spinal ganglia and cord, and compared with similar preparations from well-fed dogs. Among other changes, and preceding degeneration or atrophy, he finds that the cells shrink and become vacuolated. Upon the death of the animal the nuclei had disappeared from many of the cells. The nerve fibers, however, appeared normal.

But little has been done upon the purely physiological histology of the ganglion cell.

In 1869, Svierczewski[1] described changes in the living cells of the frog's sympathetic ganglia, changes in part probably due to functional activity of the cell. He kept the cells alive in aqueous humor or lymph under the microscope, and subjecting them to different conditions, observed the effects. It is significant to note that his attention centered upon the nucleus and its contents. The nucleoli were seen to wander about in the nucleus, sometimes in the most lively fashion, for as long as twenty-four hours. On exposing the cells to carbon dioxide, a finely granular precipitate suddenly formed within the nucleus, which redissolved on treatment with oxygen ("paraglobulin-reaction"). This process was accompanied, under certain conditions, by a marked shrinking of the nucleus, its rounded form being altered to an angular or "zick-zack" outline, the nucleolus being at the same time lost to view.

Somewhat similar observations were made by Freud[2] upon the living ganglion cells of Astacus. He describes shreds and angular-shaped particles which change form and position in the nucleus.

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[1] Zur Physiologie des Kerns und Kernkörperchens der Nervenzellen des Sympatheticus. Svierczewski. Centralblatt für die medicinischen Wissenschaften, 1869, p. 641.

[2] Ueber den Bau der Nervenfasern und Nervenzellen beim Flusskrebs. Wiener Sitzgb. 1882, p. 1.

Kühne,[1] in the course of his other studies, notes a fact which bears directly upon the present subject. This is a disarrangement and a shrinking together of the axis-cylinder fibrils of the nerves in the nictitating membrane of a frog, due to ten minutes unipolar stimulation of the nerve root within the skull. Also vacuoles make their appearance among the fibrils.

The only paper devoted to the exact problem under consideration has come out within the last month. The author states the exact question: "Is the activity of the central nervous system accompanied by changes recognizable with the microscope?"[2] He proceeds to answer the question under the idea that staining reveals much finer differences than changes of form. This determines his method, which consists in choosing two frogs of the same weight and sex, the one to be experimented with, the other for control. He then proceeds to stimulate by induction shocks the eighth nerve of one for one hour, keeping the control frog as quiet as possible during the same time. The spinal cords of both are hardened in corrosive sublimate solution and alcohol, and sections made through both cords opposite the origin of the eighth nerve. The sections are stained on the slide with haematoxylin, nigrosin, eosin, and safranin, the Gaule combination, in the order named. In *some* cases, the author states, sections of each cord are treated on the same slide. It is significant that here too the interest centers about the nuclei. These, by a difference of staining, fall into two categories, the red and the blue;

[1] Neue Untersuchungen über motorische Nervenendigung. Kühne. Zeitschrift für Biologie, 1887, p. 56, Table D, Fig. 64.

[2] Wird der thätige Zustand des Centralnervensystems von microscopisch wahrzunehmenden Veränderungen begleitet? Bohdan Korybutt-Daszkiewicz. Archiv für mik. Anat. 1889, p. 51.

and a greater proportion of the nuclei stain red in the cord of the stimulated frog. A count of all the red and all the blue nuclei in a large number of sections shows that 3.31 to 3.66 times more nuclei stain red in the stimulated than in the unstimulated frog. The results are derived from four frogs, two stimulated and two control.

We gather from this brief résumé that nerve tissue of the frog, crawfish, dog and man has been examined with special reference to the observation of changes occurring in it. The main points noted up to date are, first, changes in the appearance of the living nucleus; second, vacuolation and shrinkage of the cell protoplasm and also of the axis cylinder; and third, that the nuclei in the spinal cord. of a stimulated and unstimulated frog stain somewhat differently.

Method of Investigation.

The value of results, especially in this branch of histology, depends so much upon the soundness of the method employed, that a somewhat detailed description of some features of my method must be given. I have used in all cases the spinal root ganglia. My scheme of procedure has been throughout to stimulate electrically a nerve going to one or more of these ganglia on one side of the animal, leaving the corresponding parts on the other side at rest. To avoid possible confusion, the right side was invariably used for stimulation, the left for control. At first a double control was used, consisting of the corresponding ganglia from a similar animal of the same size and sex. This practice was soon abandoned, however, for it was found that the ganglion cells of two frogs that could not be distinguished externally might differ

very widely in staining and general appearance. The stimulated nerve was not divided, so that the contractions of the muscle supplied by it could be used to indicate the healthy condition of the nerve. If the nerve was conducting impulses peripherally to its muscle, it was taken for granted that it was conducting impulses in like manner centrally to its ganglion.

In general, as a means of stimulation, the ordinary combination was used, of Du Bois-Reymond coil, platinum electrodes, and bichromate or copper sulphate cell; and the strength of stimulus was determined within physiological limits by touching the electrodes to the tongue before beginning to stimulate. Special apparatus to regulate the strength of primary current and number of stimuli per second may best be described in connection with the purpose of special experiments. Intervals of rest were generally allowed. This was at first managed by having a key in the primary circuit and making and breaking the circuit by hand. Later, this part was relegated to clockwork, which spaced the intervals with more precision and removed the chief feature of irksomeness from the operation.

At the end of the desired length of time the stimulated ganglion, with its mate of the opposite side, was as quickly as possible excised and the process of fixing and hardening begun. The method from this point on is directed toward having the two ganglia pass through *identical treatment. In no single instance, no matter how many controls were used, were they separated from the time they left the animal to the time when, placed side by side upon the same slide, they were ready for study.* Not only were they carried through the same reagents, but, *in every case,* through the

same reagents *in the same bottles or dishes, from the first fixing fluid to the solid parafin.* And from this point *the two are cut at the same stroke of the microtome knife,* fastened to the slide together, *stained together,* and appear side by side in the same field of the microscope.

All this was made easy by a simple device, which may be of use to others. The ganglia were usually left attached to their segment of the spinal cord until ready to pass into strong alcohol. They are then trimmed for cutting, and arranged in the same position relative to each other upon one end of a small strip of mica; 1x3 cm. is a convenient size. As they lie upon the slip, a drop of the thin white of an egg is placed over them. This is allowed to dry somewhat and the whole carefully laid in the alcohol, where the egg speedily coagulates, holding the ganglia firmly to each other and to the mica slip. The rule of always placing the stimulated ganglion nearest the end of the slip aids in simplifying matters. Any desired record may be scratched upon the other end of the slip. Not only one, but several pairs can be fastened to the same slip, arranged in a row so that they all may be cut at the same time. For example, it was my practice to stimulate the right brachial and sciatic plexuses of a frog. This places at our disposal five pairs of ganglia. These may be hardened by five different methods, and all be arranged as described above on a single slip of mica. They are all cut together, fastened to the slide together (invariably by the alcohol fixing method where differences of staining or granulation are to be studied), and all stained together. Many slides are obtainable from one such set of ganglia, and each slide may be stained in a different way. This

device has given me, incidentally, a permutation of hardening and staining combinations which might well form the basis of a separate study.

In this way not only may a dozen specimens be manipulated as easily as one, but they are held in the desired positions relative to each other and, of special importance, they are cut together. However perfect the microtome, sections do not come from it of absolutely uniform thickness; and where minute, or even gross, differences of staining are to be studied, this is of prime importance.

Apropos of Korybutt-Daszkiewicz's work, I have sections, no thicker than his and obtained by essentially the same method, which show a most striking differentiation into red and blue nuclei. It requires but little focusing, however, to demonstrate that the red nuclei occupy the superficial, and the blue the deeper, layers of the section. A slight difference in the thickness of the section might thus change the proportions of the two quite materially. The thinner the section, according to the above, the larger would be the proportion of red nuclei. That this may be an explanation for Korybutt-Daszkiewicz's result is indicated by the fact that in equal areas of section he finds nearly 400 (4127 to 3759) nuclei less in the stimulated than in the control cords. This would suggest that the sections of the stimulated cords are thinner than those of the control; and from these he gets his preponderance of red nuclei.

The essential feature, then, of my method is that it compares *corresponding ganglia* of the *same animal* which have been subjected to *identical treatment* in passing from the animal to the slide; *the only point of difference being that the one has had its nerve stim-*

ulated for a longer or shorter time, while the other has not. Methods of hardening and staining do not concern us so long as the two ganglia go through every step of the processes together.

For the encouragement of others I may say that I have tried almost every method practicable and impracticable, in the hope of finding a striking reaction. Some such were found, but up to date they have all proved inconstant. Trzebinski[1] has made a special study of the influence of hardening reagents upon the ganglion cells of the spinal cord. He finds corrosive sublimate one of the best reagents, and states that it does not produce vacuolation of the cell. This method followed by Gaule's quadruple staining has furnished my best preparations for the study of granulation and staining. Trzebinski did not, it would seem, experiment with osmic acid. This, with fuchsin, safranin, or all four of the Gaule stains, has given a most beautiful preservation of the form of the nucleus and the minute structure of the cell protoplasm.

Two widely different animals, the frog and cat, were purposely selected to furnish the material for investigation. And the results which I will now consider are derived from fifteen experiments upon frogs and ten or eleven experiments upon cats. *All the experiments* will be referred to either singly or in groups.

Results.

Frog No. 1 was given three drops of 1 per cent curare solution, and the sciatic nerve of the right side was stimulated continuously for thirty minutes. The

[1] Einiges über die Einwirkung der Härtungsmethoden auf die Beschaffenheit der Ganglienzellen im Rückenmark der Hunde und Kaninchen. Trzebinski. Virchow's Archiv, Vol. 107.

three pairs of sciatic ganglia were excised and, with those of a control frog, hardened in corrosive sublimate. The ninth pairs were stained *in toto* in soda carmine; and for some unaccountable reason scarcely any nucleoli could be found in sections of the stimulated ganglion, while they appeared as usual in the ganglion of the other side and control ganglia. A count of the two gave the following:

		Nuclei.	Nucleoli.
Six sections of each contained	Resting,	122	92
	Stimulated,	177	28

The seventh and eighth pairs stained in other ways (Kleinenberg's haematoxylin and by Weigert's method) gave no such result; and in fact the phenomenon could not be made to reappear in any subsequent experiment. Other than this, no results could be made out.

Three frogs were next taken, each with a control; each was given the same amount of curare, and the right sciatic nerves of the three were stimulated continuously one, two, and three hours respectively. From the nine stimulated ganglia thus obtained no effect of activity could be discerned.

An experiment was then made to test the influence of curare upon the working of the central portion of the reflex arc, and the indications seemed quite strong that, although curare does not entirely suspend nervous action in the cord, it does reduce the activity very materially. Its further use was for this reason abandoned.[1]

Frog No. 6 was used to demonstrate *post mortem* changes in the ganglion cells, and does not concern us now.

[1] The proof that curare influenced the effect of stimulation is not conclusive, since continuous stimulation was also given up at the same time. Further experiment is needed on this point.

Frog No. 7 was made reflex, and the right brachial and sciatic plexuses were stimulated, with two minutes of rest alternating with two minutes of stimulation, for two and a half hours. The stimuli were regulated so as to be as strong as possible without causing reflex contractions of the muscles of the other side. At the end of this time but slight muscular contractions could be obtained from the arm or leg of the right side, and no reflex contractions whatever from stimulating the skin of this side, while stimulating the skin of the left side gave normal reflex contractions in that side.

Sections of the ganglia from the two sides show marked differences. Perhaps the most pronounced of these is a difference, noted independently by a number of observers, viz. that the nuclei appear shrunken in the stimulated ganglia. This led to a series of measurements, the results of which are given in the following table. The nuclei were measured, long and short diameters, in sets of one hundred, fifty stimulated and fifty unstimulated being taken from as nearly corresponding sections as possible of the two ganglia. A definite rule precluded any willful selection of the cells to be measured, the rule being that only nuclei containing nucleoli should be measured, and that all such should be taken in the order of their occurrence in the section. The measurements were made to the nearest μ under a magnifying power of Leitz, Oc. 3, Obj. 7 (= 600 diameters).

TABLE I.[1]

Frog No. 7. Made reflex, stimulated 2½ hours, in-

[1] The tables have been recomputed, and so differ slightly from those in the preliminary communication (AM. JOUR. PSYCHOL., Vol. I, p. 479 ff.). The difference is due to using the square root of the average surface of the nuclei, instead of the arithmetical mean, for the mean diameter.

tervals of rest and stimulation being two minutes. Three sets of 100 nuclei each.

		Nuclei in μ. Mean Diameters.		Cells in μ. Mean Diameters.
Ganglia hardened in corrosive sublimate. 8th pair.	Resting	13.57	Set 1.	39.69
	Stimulated	12.23		35.00
	Diff.	1.34		
9th pair.	Resting	13.94	Set 2.	
	Stimulated	12.56		
	Diff.	1.38		
2d pair.	Resting	14.48	Set 3.	
	Stimulated	13.26		
	Diff.	1.22		

Sets 1, 2 and 3, volume shrinkage, 24 per cent.

The volume shrinkage per cent is computed from the mean diameters, treating the nuclei as spheres.

Besides shrinkage of nuclei, other changes are plainly visible. The protoplasm of the stimulated cells is much more vacuolated than that of the resting, and the staining, by Gaule's quadruple method, is less intense. Instead of the coarsely and densely granular constitution of the resting cell, we find the protoplasm of the stimulated cell finely granular and vacuolated. Owing in part to this absence of granules, the nuclei are more distinct in the stimulated cells. In part this is also due to a deeper staining of the nucleus itself, the open reticular appearance of the nucleus giving place to an evenly dense stain. There can be no doubt that in my preparations the stimulated nuclei stain much bluer than the resting, except in cases where pathological conditions were present.

The five experiments succeeding this were made with the purpose of getting the greatest amount of change possible; and under the supposition that this

might be obtained, for the frog at least, in shorter time if the nutrition of the cells were prevented, the frogs were thoroughly bled or the capsules of the ganglia torn off. None of these experiments gave definite results. Sections of both ganglia stained by the above method appear redder than normal. This is presumably due to a clogging of the cells with decomposition products which would normally be carried away in the circulation. Stimulated and resting alike show vacuolation, probably the same as that found by Rosenbach in starving dogs. The nuclei in both appear shrunken, but do not show any marked difference in size.

Results of but a single experiment of this class need be given.

TABLE II.

Frog No. 8. Bled. Stimulated for 7 hours, five minutes of stimulation alternating with five minutes of rest. One set of 100 nuclei.

	MEAN DIAMETERS IN μ.	
Ganglia of 8th pair, hardened in corrosive sublimate and stained by the Gaule method.	Resting 12.36	Volume shrinkage, 8%.
	Stimulated ..12.01	

One experiment, in which the ganglia were suspended in normal salt solution while being stimulated, gave more definite results.

TABLE III.

Frog No. 14. Sciatic ganglia of right side suspended in salt solution and stimulated 3½ hours, five stimuli per second, one minute of stimulation alternating with one minute of rest. The ganglia of left side kept during this time in blood of same frog. Two sets of 100 nuclei each.

MEAN DIAMETERS IN μ.

9th ganglia; corrosive sublimate and Gaule's staining.	Resting .....14.70 Stimulated ..13.10	Diff. 1.60	Set 1. Measured by myself *previous* to Mr. W.'s measurement of set 2.
	Resting .....14.57 Stimulated ..12.14	Diff. 2.43	Set 2. Measured by Mr. W. *without knowledge of my results*, and having but one of the ganglia in the field at the same time, and *not knowing which had been stimulated and which not.*

Sets 1 and 2, volume shrinkage, 36 per cent.

It was thought that greater changes might be obtained at a higher temperature; accordingly one experiment was made to test this, and though not altogether successful, the results may be given.

TABLE IV.

Frog No. 15. Cerebrum removed and wound allowed to heal before experiment. Stimulated 5½ hours at a temperature of 35° C.; intervals of rest and stimulation being one minute. Three sets of 100 nuclei each.

MEAN DIAMETERS IN μ.

Ganglia of 2d pair. Hardened in picric acid. Gaule's stain.	Resting .....16.53 Stimulated ..15.66	Diff. .87	Set 1. Measured by myself *previous* to measurement of set 2.
	Resting .....17.40 Stimulated ..15.84	Diff. 1.56	Set 2. Measured by Mr. L. without knowledge of my own measurement, and *not knowing which of the ganglia had been stimulated.*
9th pair. Flemming. Gaule's stain.	Resting .....20.90 Stimulated ..19.13	Diff. 1.77	Set 3.

Sets 1, 2 and 3, volume shrinkage, 12.5 per cent.

It is to be noted that both Mr. W.'s and Mr. L.'s measurements make the difference greater than my own. Staining and structure of protoplasm not well defined; due probably to the fact that the frog died

toward end of experiment. At its close the muscles were beginning to pass into *rigor mortis*.

This closes the series of experiments upon frogs. It is desirable, for a more general application of the results above detailed, to ascertain whether they hold good for some other animal. Experience has shown that the most marked results are to be expected from experiments in which the condition of the animal is most nearly normal. I think I am justified in distrusting the influence of curare; from the following experiment, chloroform also would seem to be a disturbing factor. A cat was killed with chloroform, and several of the spinal ganglia were examined. Many of the cells were found to show considerable vacuolation, strikingly similar to that produced by stimulation. The point needs further investigation, but it is not altogether improbable that a substance which produces such marked physiological effects may also give rise to histological changes in nerve centers. However this may be, it was determined not to run any risk of complicating matters by the use of anaesthetics. A mode of producing insensibility without the use of drugs was accordingly resorted to.

The method[1] adopted consists in trephining the skull at about the point of greatest convexity and a centimeter to one side of the middle line. A small slit is made in the dura, and through this a blunt glass rod is thrust directly to the floor of the skull, and worked carefully across along the floor to the opposite side. The crura are thus severed at their entrance to the cerebrum; and if successful, complete anaesthesia, with normal

[1] The method was obtained from a paper entitled "On the Renal Circulation during Fever" (Walter Mendelson, Am. J. M. Sc., Phila. 1883), where the method is credited to Ludwig.

pulse and respiration, should result. The operation is performed while the animal is under slight anaesthesia from ether. The right brachial plexus is then laid bare in the axilla, and, with great care as regards injuring the nerves or blood-vessels going to them, freed from fat and disentangled from the subclavian artery and vein, so that these may not be included between the electrodes. By including the whole plexus at this point, four ganglia are stimulated. My own practice has been to slip a two-tined platinum electrode over the plexus from behind, in such a way that the two tines of the electrode touch opposite sides of the nerves and make it necessary for the stimulus to pass obliquely through them. The greater number of the fibers, however, from the 6th and 7th cervical escape stimulation, and possibly, too, the nerves from the 1st dorsal and 8th cervical coming first between the electrodes, tends somewhat to short circuit the current, thus depriving the other nerves of an equal share of the stimulation. At any rate, the 6th and 7th cervical have failed to show the effect of stimulation to the extent that the 8th cervical and 1st dorsal do. Hence for the clearest results it is best to include in the circuit only the medius and spiralis nerves and the branches lying behind these, and then use only the 8th cervical and 1st thoracic ganglia. A double control was employed at first, consisting of thoracic ganglia from the same animal, a pair of these being carried through with each pair of test ganglia. This was soon found to be entirely unnecessary, since the cells of these control ganglia invariably resembled those of the resting ganglion.

TABLE V.

Cat No. 1. Stimulated for 7 hours; intervals, one minute.

Ganglia of		Nuclei (four sets 100 each). Mean Diameters in μ.	Shrinkage in Volume.	Cells. Mean Diameters in μ.
1st thoracic. Hardened in osmic acid.	Resting	16.29		59.06
	Stimulated	14.07	35%	57.19
	Diff.	2.22		
8th cervical. Hardened in corrosive sublimate.	Resting	14.91	(Selected).	All over 50 μ.
	Stimulated	11.70	51% (T.)†	
	Diff.	3.21		
7th cervical. Hardened in Flemming's fluid.	Resting	16.60		57.50
	Stimulated	15.41	20%	56.25
	Diff.	1.19		
6th cervical. Hardened in picric acid.	Resting	14.98		44.21
	Stimulated	14.23	14.6%	44.74
	Diff.	.75		

Stimulation severe, frequently varied and regulated so as to produce the greatest amount possible of muscular contraction in the right fore-leg without giving rise to reflex contractions in other parts of the animal. Muscular contractions in right fore-leg toward close of experiment feeble but constant. Within five minutes after the animal was bled the muscles of this leg had passed into *rigor mortis*, the muscles of other limbs being normal and irritable. Pulse and respiration remained normal the whole time.

Besides shrinkage of the nuclei, other important changes occur. For the first thoracic pair, hardened in osmic acid, the nuclei are plump and round in the resting ganglia and stain lighter than the protoplasm. In the stimulated ganglion they are irregular in outline and stain much darker than the rest of the cell. Especially marked in this case also is the extreme vacuolation of protoplasm in the stimulated cells, and this does not occur in the ganglion of the other side or

† See explanation page 395, note.

in the two thoracic ganglia used as control. It was noticed independently by three observers that the nuclei of the cell capsule were shrunken in the stimulated ganglion. (See Figs. 3 and 4 of plate.) The eighth cervical ganglia, hardened in corrosive sublimate, show the characteristic appearance of the nuclei, with slight difference in the staining of the protoplasm.

TABLE VI.

Cat No. 2. Stimulated 1 hour 40 minutes; intervals, one minute.

		100 NUCLEI.		100 CELLS.
		Mean Diameters in μ.	Shrinkage in Volume.	Mean Diameters in μ.
Ganglia of 1st thoracic. Osmic acid.	Resting	14.91	25.6%	14.94
	Stimulated	13.51		14.45
	Diff.	1.40		

Examination of the sections shows changes similar to those described for cat No. 1, but less in degree.

Though no attempt was made to render the stimulation equal for cats No. 1 and 2, it is hinted by the results of the two experiments that some sort of a quantitative relation exists between amount of stimulation and amount of change in the cells. Such a relation should obtain if we are dealing with cause and effect. To test this point with theoretical precision is, of course, impossible, for we must know, in order to do this, not only the strength of stimulus used, but also that the same amount of stimulation is distributed to the same number of cells; and, further, that the ganglion cells of one animal are exactly as irritable as those of another animal. In the following series, therefore, we assume that the irritability of cats is in general the same, and that the same nerves in different cats connect approximately with the same number of ganglion cells. To render these factors as

nearly alike as possible, half-grown kittens were used throughout. The amount of stimulation was regulated by using the same apparatus for all the experiments, and by placing a rheocord, resistance-box and galvanometer in the primary circuit derived from two one-liter copper sulphate cells. By manipulation of the resistance-box and rheocord, the galvanometer needle was brought to a given position and held at this point during each experiment of the series. The results require little more than tabulation.

TABLE VII.

SERIES WITH EQUAL STIMULATION.

Intervals of 15 seconds of stimulation alternate with 45 seconds rest. Ganglia of 1st thoracic pair, hardened in osmic acid.

	Length of Stimulation.	No. of Nuclei Measured.	Mean Diameters of Nuclei in μ.	Shrinkage in Area of Section of Nucleus.	Shrinkage in Volume of Nucleus.
Cat No. 7 (operated upon and left without stimulation for 2½ hrs.)	0 hrs.	100	14.20 14.54	—4.7%	*—6.9%
Cat No. 5	1 "	100	14.70 13.51	+14.1%	+22%
Cat No. 6	2½ "	200 (T.)†	11.86 10.95	+13.8%	+21%
Cat No. 8	5 "	100	15.97 14.38	+17.1%	+24.3%
Cat No. 11	10 "	100	16.19 13.35	+31%	+43.9%
		‡S. 100			
		S. 100 (T.)			
		100 (T.)			

*The minus sign indicates that the nuclei of the right ganglion are larger in this case. In the only other set measured from a normal pair, the nuclei were also slightly larger in the ganglion of the right side.

†Sets marked T. are measured by a third person, with whom every precaution was taken to obtain a purely mechanical and unprejudiced measurement.

‡Sets marked S. are those in which only nuclei in cells of over 50 μ diameter were measured.

TWO EXPERIMENTS WITH STRONGER STIMULATION.

		Time.	No. of Nuclei Measured.	Mean Diam.	Area Shrinkage.	Volume of Shrinkage.
1st thoracic ganglia. Osmic acid.	*Cat No.* 9 (45 seconds rest to 15 seconds work)	2 hrs.	100	12.39 10.45	31%	40.9%
	Cat No. 10 (intervals 15 seconds rest to 15 seconds work)	2 hrs.	100 (T.)	13.82 12.04	23.9%	32.7%

In the above series the stimulus used was very slight, too slight for the most definite results. Still no special study of the sections is necessary to detect the gradation expressed in the table, staining as above described. The use of the one reagent throughout the series has emphasized the fact that osmic acid is not so strongly reduced by the cells of the stimulated ganglia. This sometimes results in so marked a difference in staining that sections of the two ganglia may be easily distinguished by the naked eye. The vacuolation, so striking in the stimulated cells of No. 1, is only slightly present in these experiments, presumably because the stimuli were not strong enough.

Many devices were resorted to to eliminate the personal equation and obtain mechanical measurements. Three persons unacquainted with the methods of the investigation have kindly consented to assist in the work of measuring. Even here the differences are too marked to make an absolutely neutral state of mind possible, since each of the three, before completing the measurement of a single set, had a very definite notion that the nuclei in the two ganglia were different. In my own measurements I was wont from

the first to throw all thought of the work as completely as possible off my mind, to think about something else, to have a story in which I was interested read aloud, or something of the kind to divert my attention. In general also all the measurements were made before the results were footed up, so that the way they were tending could have no unconscious influence upon the measurements.

The objection has been raised that the changes above described, especially shrinkage of the nucleus, may be pathological. It is true they resemble changes hitherto described as pathological; but up to the present no attempt has been made to distinguish changes due to fatigue from those caused by disease, and on *a priori* grounds we should expect the former to precede and shade into the latter. The fact that the change becomes steadily greater as the stimulation is prolonged, would further indicate that it is due to active processes of the living cell. It would be interesting to know whether stimulated cells will return to the normal condition if given a sufficiently long period of rest. But whether they do this, or whether they die and give place to new cells, is a point for future investigation, and not the question in hand. In either case we are safe in assuming that the changes are such as occur in the normal working of the ganglion cell.

Conclusion.

A method has been attained by which changes due to functional activity can be as easily and certainly demonstrated in a ganglion as in a gland. The chief of these changes for the spinal ganglion cells of the frog and cat are:

As a result of electrical stimulation:

A. For the nucleus: 1. Marked decrease in size.

2. Change from a smooth and rounded to a jagged, irregular outline. 3. Loss of open reticular appearance with darker stain.

B. For the cell protoplasm: 1. Slight shrinkage in size. 2. Lessened power to stain or to reduce osmic acid. 3. Vacuolation.

C. For the cell capsule: Decrease in size of the nuclei.

Incidental Observations.

A number of suggestive observations, made in the course of the investigation and not belonging properly to the body of the paper, may be mentioned here.

A strange differentiation of some sort between the large and small cells of the spinal ganglia is brought to light by stimulation. The large cells show the effects of work; the small cells, very little or not at all. The fact is too marked to pass by unnoticed. Considering all the cells large which have one diameter 50 μ or over, and those small which have not, a count gives the following result:

Cat No. 11. *First Thoracic Ganglia.*

	In 100 large cells nuclei:		In 100 small cells nuclei:	
	Shrunken.	Not shrunken.	Shrunken.	Not shrunken.
Resting,	5	95	0	100
Stimulated,	94	6	8	92

A few fibers going to a ganglion of course escape stimulation by our method. This accounts very well for the few large cells which do not appear worked in the stimulated ganglion. It cannot account for this condition in the multitude of small cells which comprise over half the cells in a ganglion. No explanation will be attempted until further experiment is made. As might be expected, a few cells in the resting ganglion appear worked.

In close relation to our work is the question of the

minute structure of a spinal ganglion. What is the path of a nerve impulse through the ganglion? The supposition has been, since Ranvier's work, that a fiber enters a spinal ganglion, unites with one of its cells by a "T" process, and passes out in the opposite direction. This supposition finds support in the way a nerve degenerates when separated from the ganglion, and in the fact that the same number of fibers enter a ganglion as leave it.[1] It is also supported by Birge's[2] work, in which he finds a single ganglion cell in the anterior horn of the frog's spinal cord for each nerve fiber in the anterior root. If this relation holds for the cells and fibers of the spinal ganglion, we should evidently find a cell in the ganglion for each fiber in the posterior root. Expecting to demonstrate this, Dr. Nelson,[3] working under the direction of Birge in the University of Wisconsin, counted the fibers in the posterior root and the cells in the corresponding ganglion. The work was done on the frog, and in all about ten ganglia were counted. Nelson found, allowing 2–4 per cent for error in counting, *two* ganglion cells for every fiber in the root. This counting has been repeated for two ganglia by myself, and for one more by still another observer. Our figures are as follows:

	No. fibers in root.	No. of cells in ganglion.
Seventh ganglion, right side,	1128	2767
Eighth " left "	1811	5416
Seventh " left "	1340 (T.'s count) 1364 (my count)	4456 (T.)†

[1] Ueber den Bau der Spinalganglien. M. Hall. Wiener Acad. Sitzungsber. LXXII, 3, p. 31–37.

[2] Die Zahl der Nervenfasern und der motorischen Ganglienzellen im Rückenmark des Frosches. E. A. Birge. Archiv für Anat. und Phys. 1882, Physiol. Abth. p. 435.

[3] The above is inserted by the courtesy of Dr. Nelson. His notes of the work were destroyed in the burning of Science Hall, Madison, Wisconsin.

† The most careful count of all, done under magnifying power of Leitz, Obj. 7, Oc. 3 (= 600 diameters) for fibers, and Obj. 7, Oc. 1 = 325 diameters for cells.

The method consisted in counting all the nucleoli *in every section of a complete series through* the ganglion, and all the fibers in a cross section of the root between the ganglion and the cord, generally close to the ganglion. The tissue is hardened in osmic acid. A nucleolus may be pushed to one side or dragged out of a cell by the edge of the knife, but is never cut in two. So we run no risk on that score of counting a cell twice; and double nucleoli are so rare that they may be left out of the account.[1] My rule throughout was to count everything that could be construed to be a fiber in the root, and nothing but what was most certainly a cell in the ganglion, thus throwing all the doubtful cases upon the same side.

With the above figures approximately correct, either apolar cells in the ganglia must be very numerous, or the relations of fibers to cells must be more complex than formerly supposed. A most careful teasing of spinal ganglia of a frog, using a fine jet of water instead of needles, I think demonstrates the following points:

1. Apolar cells do not occur in the spinal ganglia of the frog in any considerable numbers, none having been observed.

2. Typical bipolar cells do occur. Three have been noted up to date.

3. The axis cylinder of the cell process is often seen to divide and enter the cell as a spiral and straight fiber.

4. At the angles of the "T" the axis cylinder of the cell process may be observed to divide and pass

[1] In counting the last ganglion, T. kept careful account of all double nucleoli. In the 4456 cells 38 were found. In all cases they were found in the small cells, lying among the fibers or close to the nerve fiber axis of the ganglion.

both ways in the nerve fiber, of which it *seldom* forms the whole of the axis cylinder.

5. Two cases of double ⊣⊢ have been found.

6. Two cells, in a number of cases, have been found to unite their processes, not necessarily as a cell junction, but to aid in making the axis cylinder of the same nerve fiber.

No rigor has been spared in this teasing from fear of breaking specimens. The coverslip has been tapped and each specimen rolled over and over while under the microscope until every point in the above description has been clearly demonstrated. A special investigation of these points is under way.

In the course of examining so many cells, an appearance of the nucleus has been noticed which may throw some light upon that most vexed problem, the minute structure of the ganglion cell itself. The marked effect upon the nucleus of stimulation would indicate an intimate relation between the nerve fiber and the nucleus. In general, the jagged points of a worked nucleus give the impression that it is connected at these points with the fibrillar reticulum of the cell protoplasm. At times, and not so very rarely, something more definite makes its appearance. A stream of fibrils is plainly seen to pass from one side of the nucleus to mingle with the fibrils of the cell. These fibrils arise from the nuclear membrane, and in no case have I been able to trace them to an origin within the nucleus.

March 15, 1889.

(For explanation of plate see page 402.)

Explanation of Plate.

Fig. 1.—*Cat No.* 11. Left 1st thoracic ganglion, resting. A portion of single field. Nuclei full and round, protoplasm darkly stained.

Fig. 2.—*Cat No.* 11. Right 1st thoracic ganglion worked, not severely, 10 hours. Cells *a* and *b* are adjoining cells, taken from a slightly more central portion of the section, and show an appearance of the nucleus, shrunken away from the cell protoplasm, quite characteristic for central portions of the worked ganglion, but not of the resting.

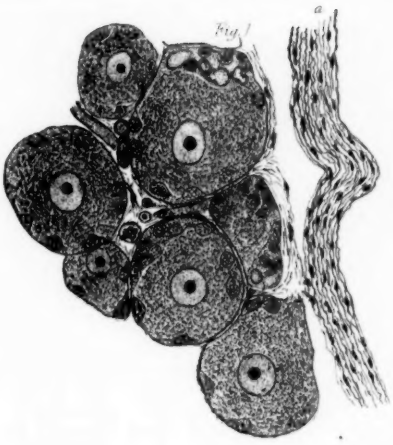
Fig. 3.—*Cat No.* 1. Cell from left 1st thoracic ganglion, *resting*. Adjoining cells outlined in part.

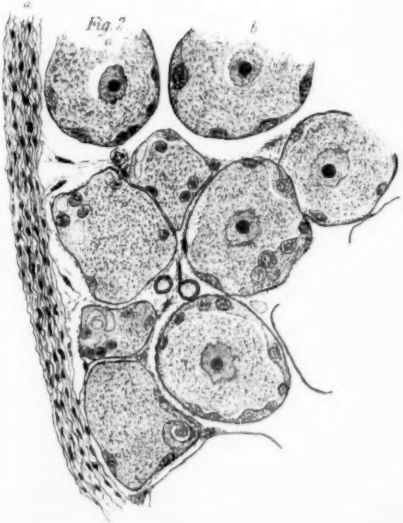
Fig. 4.—*Cat No.* 1. Cell from right 1st thoracic ganglion, *worked severely 7 hours*. Nucleus much shrunken and protoplasm vacuolated. 1 and 1′ two larger vacuoles.

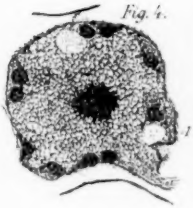
Note.—All the above figures were drawn under a magnification of Leitz Obj. 7, Oc. 3 (=600 diameters), and the cells, nuclei and nuclei of capsule were outlined by the aid of a Zeiss camera lucida after Abbe (the form with the longer arm).

Figs. 1 and 2, staining with osmic acid.

Figs. 3 and 4, staining with osmic acid followed by Gaule's quadruple stain.







C.F. HODGE. Del.

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PERSONAL EQUATION.

EDMUND C. SANFORD, PH. D.

III.

The Nature and Cause of Personal Equation.

In the preceding section of this study, a number of conditions were set forth that may cause the personal equation to vary. In this I propose to exclude all such, and to consider the personal equation in itself under the simplest conditions. It is evident at once that even so, there will be room for classification. The personal equation differs in the two methods of observation, chronographic and eye and ear, and in the individual applications of each. I shall begin with the chronographic, because from a psychological standpoint it is the simplest; and with the observation of a sudden phenomenon, the precise instant of which cannot be foreknown; for example, the emergence of a star from the dark edge of the moon, or a heliotrope signal.

Identically the same thing has been studied by the physiological psychologists under the name of "reaction-times without signal."[1] A stimulus is received by the sense organ (here the retina); the impulse is conducted to the brain; brain changes result, accom-

[1] Wundt: Physiologische Psychologie, 3te Aufl., II, 287. It is customary in most reaction-time experiments to give warning of the approach of the stimulus to be observed, at a short but variable time before its occurrence.

panied on the psychic side by perception, apperception and volition;[1] a motor impulse starts out along the nerves of the arm; the muscular motion of tapping the key is executed; and the reaction is complete. The whole requires over a quarter of a second.[2] The portion to be credited to each stage is still extremely uncertain, but the sense organ and the muscles have short latent periods, the nervous conduction takes time, and the brain changes are very likely slowest of all. The absolute personal equations for this kind of observing should be 0.30 s or over; and, since no one can observe the event before it happens, the relative should be reduced to a few hundredths of a second.

When the instant of the phenomenon can be foreseen with some exactness, as in transit observations, the process is a little different. The two ways of applying the method (waiting for the bisection, or anticipating it) must further be distinguished. The first corresponds closely to the "reaction-times with signal" of the psychologists, the steady approach to the wire giving most exact warning of the time to record. Reaction-times with a signal, as shown by the little table below, are shorter than those without—in gen-

[1] Perception, apperception and volition mean here respectively, the first consciousness that a sensation is reaching the sensorium, the clear consciousness of the sensation, and the determination to react to it. For a practiced observer reacting to a stimulus of moderate intensity, the last two stages are more or less overlapped.

[2] Wundt gives values for reaction to the sound of a falling ball, with and without signal, as follows:

	Fall of 5 cm.	Fall of 25 cm.
	s.	s.
Without signal,	0.266	0.253
With signal,	0.175	0.076

The reaction-time for light is in general greater than that for sound. The experiments of Renz (*Astr. Nachrichten*, CXIX, 1888, 145) give values for the disappearance and reappearance of an artificial star varying from 0.40 to 0.60 s as the star declines in brightness.

eral, because the signal gives a chance for focusing the attention, tensing up the muscles, etc., and in particular because, when the stimulus is not too faint, it favors the use of the "motor form of reaction."[1]

In this form the attention is turned not to the stimulus, but with extreme concentration to the execution of the reaction; and there is a corresponding tension in the reacting member. The times with this form are about 0.1 s shorter than when the attention is concentrated on the stimulus, even when that is preceded by a signal, that is, for light, from 0.15 to 0.19 s. Wundt considers that when fully established, reaction after this form is probably an acquired brain reflex. The sensation on its entrance into the general field of consciousness at once releases the motor impulse without the mediation of the will, and the apperception of it takes place while the response to it is in execution. The extra-cerebral stages are as before, and may be assumed to be the same in time, except for the additional muscle tension. I am not able to say how frequent this form of reaction is among astronomers, but it is largely a matter of practice and may be frequent among them.

The observers that anticipate introduce still another element. Instead of reacting to an independent sensory stimulus, they react to a stimulus as affected by judgment—that is to say, they tap the key when they see the star in such a position that they judge from its rate and distance that it will be bisected when the key is tapped. The judgment is of course only semi-conscious, if conscious at all, but nevertheless maintains its character. The effect of this way of using the chronographic method in varying conditions has

[1] Wundt, op. cit. II, 265–267.

already been shown. It certainly adds a rather complex psychological process to those before mentioned, though not one that need make any great difference in accuracy while conditions remain the same.

It is hardly necessary to point out that in all these cases the direct cause of the personal equation is the physiological inertia of the observer. To this the anticipators add a mental factor that compensates partially or wholly, or over-compensates, the physiological delay. Astronomers can therefore hardly hope to free their chronographic observations absolutely from the variations of personal equation. The nearest approach is probably to be found in the use of suitable artificial transits at the time and under the circumstances of the observations to be corrected.

The Eye and Ear Method.

In this method the processes are more complicated than in the last. Instead of executing a definite and predetermined motion in response to a definite sensation, the observer has here to fix disparate sensations with reference to one another—a much more difficult thing to do and one more open to illusion. The greater difficulty is witnessed by the larger probable errors and personal differences that attend this method.[1]

Let me first take up as before the observation of instantaneous phenomena. It is more than likely that in this method, as in the other, foreknowledge of the time at which the phenomenon is to appear, affects the observing of it; but such figures as I have found are insufficient to establish such a difference, and I must therefore speak of both cases together.

[1] American Journal of Psychology, II, 20–21 and 272.

The absolute error in observations of this kind has been measured by Renz with artificial stars.[1] In the preliminary report published the average values are irregular and for the most part do not exceed a few hundredths of a second. Whether this same result would be found with longer series and on other individuals remains to be seen. Determinations of relative personal difference in observing a sudden sound were made by Encke.[2] The mean result of two series was as follows:

$$\begin{aligned} E-B &= +0.261^{s.} \\ E-F &= +0.031 \\ E-Q &= +0.083 \end{aligned}$$

The observer B, before knowing the result of the observations, remarked that he felt he had observed much too soon. The mean of two series taken later showed him in the right:

$$\begin{aligned} E-B &= +0.026^{s.} \\ E-F &= +0.032 \end{aligned}$$

Later still, observers B and Q found as the mean of three series of comparisons:

$$Q-B = +0.130^{s.}$$

The mechanism of the observation is easy to understand. The observer receives and counts the regular series of auditory sensations, and into this at some point is shot a sensation of sight.[3] The auditory sensations are practically instantaneous, that of sight leaves an after-image. The senses operate quite as

[1] *Astr. Nachrichten*, CXIX, 1888, 145.

[2] Abhandlungen der Berliner Akademie, 1858.

[3] It makes no great difference whether the observer attends at the instant of observation to a subjective clock-beat, as Wolf thinks, nor whether he counts mentally; that there should be subjective hearing and subjective counting is sufficient.

usual, and we must look elsewhere for the largest part of the error. One can follow the rhythm of the seconds with very great accuracy; it is the entrance of the new stimulus, and, as I hope will appear before the end of the paper, the disturbance of attention thus produced that are really to blame.

The sight stimulus may fall either very near one of the auditory series or in the midst between two, and there is room for some difference in the result according to which happens: if the first, the persistence of the sensations is involved; if the second, the estimate of time. On the first, some light is thrown by experiments of Exner, the Vienna physiologist.[1]

Exner's problem was: How far apart in time must two stimuli be in order to be perceived as successive? The first part of his study deals with stimuli to the same sense; for sight he used electric sparks or little illuminated holes seen one after another through a slit in a revolving disk; and for hearing, the clicks of a lead slip held against a toothed wheel. The next—and these experiments are most like the observations in question—refers to stimuli to different senses. His apparatus furnished a bell stroke and an electric spark, or a shock and a spark, of which the order and separation in time could be varied by an assistant. The observer was required to say whether the sensations were simultaneous, and if not, which came first. The couple were apparently repeated a number of times in the same order before a judgment was made. There are not many experiments reported, and the results are not easy to gather in statistical shape, but they show that "if a sense impression acts simultaneously on both eye and ear, the sensation of hearing

[1] Pflüger's Archiv, Bd. XI, pp. 422–428.

will be perceived earlier than the sensation of sight," and they further give the basis for the second part of the table of approximate times (Exner himself as observer), with which he concludes that section of his article. I extract from his table those values that are of interest in this connection; the double stimuli are supposed to occur in the order given.

	s.
Two noises	0.002
Spark images at the center of the retina	0.044
Bright disks " " " "	0.045
Noises at the two ears	0.064
Hearing—sight	0.06
Sight—hearing	0.16
Touch—sight	0.053
Sight—touch	0.071

In this table it is to be noticed that the time is lengthened when the stimuli reach different senses (or even different sense organs, in the case of the ears); and further, that the times are longer when sight leads, because of the longer after-sensation in that sense, and longest of all when sight leads and hearing follows.[1] The hypothesis that the difference depends largely on the adjustment of attention is supported by Exner's subjective observations. He thus describes the subjective side of the double stimuli experiments:

"A second way of adjusting consists in the following: We adjust for a definite one of the two stimuli, *e. g.* for a bell stroke in connection with the state of the sensorium at the instant of this bell stroke.[2] Then

[1] In experiments with hearing and touch, the perception of succession was much more exact, but the amount of separation necessary did not appear.

[2] In speaking of the first way of adjusting he had said: "We adjust the attention for the first sense stimulus that is to strike us, without knowing which it is, of course. Not for this alone, however, but for the state of the sensorium—I cannot express myself differently—at the instant of the first sense stimulus."

the other stimulus, *e. g.* the electric spark, comes into relation with the first either as preceding or following. One circumstance is here highly disturbing. The impression that is not adjusted for is much weaker in the memory-image than the one adjusted for; it is somewhat indistinct, poorly fixed as to time. There is, therefore, great uncertainty in this method. Usually the inclination is to take the subjectively stronger stimulus, the one adjusted for, for the first, just as the inclination is to take a considerably stronger objective stimulus for the first. Still the whole circumstance can also be reversed; it was in the experiments between touch and sight. There it often seemed to me as if the impression not fixed had already taken place at the time of the fixed; the phenomenon can suddenly change over again into the usual form. A similar phenomenon has been described by Wundt.[1] He states that between sight and hearing he can voluntarily perceive one or the other stimulus earlier according as he turns his attention to them. I have never succeeded with this combination, and the physiological delay of the sight impression comes into consideration, which Wundt had not yet recognized."[2]

[1] Vorlesungen über Menschen- und Thierseele, Leipzig, 1863, I, 39.

[2] In the last edition of his *Physiologische Psychologie*, Wundt makes a similar statement. In speaking of the effect on the simple reaction-time of introducing a stimulus to another sense at almost the same instant as that to be reacted to, he says (II, 294): "Provisionally it may be remarked that the succession of our sense perceptions does not necessarily agree in order with the succession of sense stimuli, but that an actually later impression can readily be anticipated. Introspection leaves no doubt as to the origin of these illusions; they rest on the varying tension of attention. As soon as the tension for the chief sensation has risen to a certain point, it can bring that sensation, even when it actually follows somewhat later than the accompanying stimulus, in spite of that, into the focus of consciousness at the same time or earlier. The greater the attention the more marked will be the difference in time that can be overcome by it." See also II, 339.

It is evident, of course, that so long as a subject adjusted indifferently now for one sensation and now for the other, his observations would show accidental errors only; but if for any reason he habitually attended to one or the other, a constant error might enter and he would show a personal equation.

It may be mentioned in this connection that Encke found a small personal difference in observing the coincidences of the beats of two clocks running at slightly different rates,[1] and Littrow reports experiments of Weiss's to similar effect.[2]

All this, however, applies only when the phenomenon to be observed falls near one of the second beats. When it falls in the middle of the second, another service is required of the mind, one that probably introduces another error, namely, the estimation of the fractional parts of the second. Unfortunately there are no experimental determinations, so far as I am aware, of this factor. The time-sense has been studied somewhat, but with a different end in view. It may be conjectured that here also attention plays an important role. The grounds of this conjecture and of what has already been said about the function of attention will be somewhat strengthened by what is to be said in the next section, though the reference is not direct enough to justify repetition.

Transit Observations by the Eye and Ear Method.

Much more important, from an astronomical point of view, than the last, is the application of the eye and ear method to the observation of transits. The opera-

[1] Abhandlungen der Berliner Akademie, 1858.

[2] *Astr. Nachrichten*, LXVIII, 1867, 369.

tions are here very different from those just considered, and more uniform in results, though still attended by considerable personal differences. The effort is to fix two points in the continuous line of motion of the star, one after and one before the crossing of the wire, which shall correspond with successive beats of the clock, to estimate the position of the wire between the two in tenths of the whole space, and thus finally to arrive at the time of the crossing in tenths of a second. The stage at which the important personal differences seem to enter is the connecting of the clock-beat with the position of the star.

The first and chief theory put forward in explanation of these is that of Bessel, given in his original study.[1] He says:

"These different experiments show that no observer, even if he believes he follows Bradley's method of observation in all strictness, can be sure to tell the *absolute* instant of time correctly. If it is assumed that impressions on the eye and the ear cannot be compared with each other in an instant, and that two observers use *different* times for the carrying over of the one impression upon the other, a difference originates—yet a greater, indeed, if one goes over from seeing to hearing, the other from hearing to seeing. That different kinds of observation should be able to alter this difference need not seem strange, if one assumes as probable that an impression on one of two senses *alone* will be perceived either quite or nearly in the same instant that it happens, and that only the entrance of a second impression produces a disturb-

[1] Königsberg Observations, Abth. VIII, 1822, iii; also his Abhandlungen, Bd. III, p. 303.

ance which varies according to the differing nature of the latter. It is probable that Maskelyne would have agreed more nearly with me than with Struve, Walbeck or Argelander, since in the opposite case a difference of about two seconds would have occurred between Kinnebrook and me, which is surely too great to be considered possible. Maskelyne and I therefore probably follow the custom of going over from hearing the second-beat to seeing, while the astronomers observing later appear to have accepted the contrary."[1]

Bessel's theory was suggested no doubt by his own mental processes in observing, and probably has commended itself to astronomers for similar reasons. Hartmann noticed something of the kind in his experiments,[2] and C. Wolf likewise, at least in his earlier ones, though he had never perceived it in actual observations. "I have been able to establish the existence of this dead time very easily," he says; "I listened to

[1] Faye illustrates the same theory as follows (Comptes rendus, LIX (1864) 475): "Imagine a moment," says he, "that the mind is an eye placed inside the brain, an eye attentive to the modifications that each sensation determines in the nervous tracts, that end there. If sensations of the same nature are produced at the same point, this inner eye will easily judge whether they are successive or simultaneous; but if they arise from different senses whose nerves end in different regions of the brain, the inner eye will have to move in order to pass from one region to another, and the time thus employed will not be perceived; sensations separated by a very real interval will be noted falsely as simultaneous. The time lost, the time thus employed in going from one sensation to the other, can amount to more than a second. It will vary from one individual to another according to the rapidity with which his inner eye is moved to contemplate successively the keys of that prodigiously complex keyboard that we call the brain.

"I do not need to say that I attach no reality to this comparison; our mind is not an inner eye. Nevertheless, the necessity of comparing two sensations of different origin condemns the mind to a peculiar labor, since it uses a time so considerable to establish a communication between different nervous tracts. This task is also very fatiguing, while the comparison of sensations of the same origin is not so, or is a good deal less so."

[2] AMER. JOUR. PSYCHOLOGY, II, 29.

the second, and when the sound had been perceived I brought my attention to the position occupied by the star."

Of similar import is a series of experiments by Wundt,[1] in which the observer tried to fix the position of a pointer (sweeping over a divided arc) which corresponded to the production of a sound or other stimulus. This is hard to do, and it is necessary to allow the sound to come a number of times in succession before any confident judgment can be made, and even of the results so obtained a very large number are necessary to average out accidental variations. It is easy, for example, to unite the sound with a predetermined position of the pointer, if not too far from the true one; and if all the scale is covered except the single division, the error may amount to a quarter second.

At moderate velocities the sound is regularly associated with too early a position. As the rate of both pointer and recurring sounds is increased, the error lessens and becomes zero—for Wundt himself, when the divisions of the scale are passed over in about $\frac{1}{36}$ second each and the sounds are a second apart. If the rate is still further increased the error changes sign, that is, the sound is connected with a position later than the true one. This, however, cannot go far, because the divisions are soon swept over too rapidly to be distinctly seen.[2]

The error changes in the same way also when, instead of a single sound, a sound and an electric

[1] Physiologische Psychologie, II, 334 ff.

[2] Relative personal equations would appear whenever individuals differed in the results obtained in these experiments. One of Wundt's subjects in experiments of this kind always fixed a position of the pointer before the real one.

shock, or a sound and another sound of a different kind, are produced together. The two are perceived as simultaneous, but both are associated with a position of the pointer less behind its true position. A third sensation added changes the sign of the error, and a fourth carries it still further in the same direction. The little table below gives the amount of the error (the average at three rates) for four additions; those marked minus are too early, those plus are too late:

First added stimulus	−0.0670
Second " "	−0.0113
Third " "	+0.0296
Fourth " "	+0.0399

I pass by developments of these experiments, not immediately concerned with the point in question, to notice Wundt's interpretation of his results. It is something as follows. The division of the scale with which the sound shall be connected depends within certain limits on the adjustment of attention alone,[1] and this is in turn influenced by the rate at which the sounds succeed one another and the pointer moves over the scale. When the rate is such that attention is just at its maximum when the sound is each time produced, there is no error; the sound is associated with the true position of the pointer. When the rate is slower the adjustment takes place too soon and the sound is associated with a position earlier than the true one. When the rate is faster the adjustment is too late and the position later than the true one. The speed at which the pointer moves also influences the rate of adjustment; as the pointer moves fast or slow

[1] The attention may be thought of as rising rhythmically again and again like a wave, the time at which it reaches its maximum fixing the time at which the sensation to which it is directed will be perceived.

the adjustment is made rapidly or slowly. When other stimuli are sent in at the same time as the sound, the adjustment becomes more difficult and the time required for it longer; hence the tendency of the first error to grow less and finally to change sign.

Wundt's "adjustment of attention" is only the psychological explanation of Bessel's indefinite "carrying over of one sensation upon another." Both are agreed in putting the cause of personal equation in the difficulty the mind finds in uniting disparate sensations. C. Wolfe,[1] however, believes that, when such errors as these have been removed by training, there still remains an error due to purely physiological causes. To the examination of this theory and the experiments upon which it rests I turn next.

Wolf clears the ground for the discussion by collecting a large number of personal differences and showing that those larger than 0.3 s are rare. At the beginning of his experiments his own absolute personal equation was of that amount, but as they continued it fell rapidly to 0.11 s, and there remained fairly constant as if it had reached a physiological limit. In the instant of observation an observer does not hear the actual clock-beats, but follows an inner series; he may even go on to complete an observation when the real beats have ceased, without knowing the difference. If this is so, what becomes of the superposition of dissimilar sensations? And again, the seconds need not be taken by ear, but by touch or even by sight, and yet the personal equation remains practically the same.

These last are interesting observations, but it must

[1] Annales de l'observatoire de Paris; Mémoires, VIII, 185 ff.

be perfectly clear that they have no force against Bessel. The illusion of a clock-beat is of its very nature the same to the mind as a real one. When the second is taken by touch there is a dissimilar sensation to be united with that of sight as much as when the second is heard, and even where it is taken by sight there are two things to be attended to, the time and the position of the star, to say nothing of the incipient muscular discharges that probably accompany even subjective counting.

Wolf's theory, however, does not fall with these general arguments; its corner-stone is the following set of experiments. Making use again of his artificial transits, he had, instead of the single little illuminated hole that gave him his star before, three little holes close together in the same vertical line. The upper and lower were illuminated at intervals by induction sparks, the middle one constantly. As long as the plate containing the holes was still, all three seemed, as they really were, in the same vertical line. When the plate was in motion, the constantly illuminated star seemed in advance of the sparks whichever the direction of motion, and further in advance as the rate was more rapid. If the sparks flashed irregularly the star was clear cut; if they flashed regularly, say every second, so that they might be anticipated, the star, though as far ahead as before, had behind it a train extending backward as far as the line connecting the sparks. If the star was made to disappear at the instant the sparks flashed, it was seen as at first on the same line with them.

The interpretation of these experiments is so important to Wolf's theory that I give his own words:

"These experiments seem to me to contain all the

facts relative to the personal equation in the case where the second is perceived by sight, and to give the explanation of it. In the first place, the last shows us that the deviation of the star is a pure illusion. The first [*i. e.* that in which the sparks flash irregularly and the star is seen ahead of the sparks without a train] represents very nearly the phenomenon cited by M. Faye to explain the ordinary error of observation. At the unforeseen moment when the sparks flash, the eye, surprised by their apparition, turns its whole attention to them, ceases to see the star (which continues its movement), and does not return to it before the sparks have disappeared. The star has then advanced, and appears in advance by an amount *equivalent to the time during which the luminous impression of the two sparks persists.* There is then, to be sure, between the moment when the second is perceived and the moment when the eye registers the position of the star, a lost time; but in place of attributing, with M. Faye, a purely psychological cause to this lost time, I find for it a physiological origin and a value physiologically determined. The error committed in the estimate of the position of the star is equal to the duration of the persistence of the luminous impression.

"But this case, I have said, is not really that of an experienced observer that perceives the sensation of a perfectly rhythmed second. It is necessary then to go to the second experiment [*i. e.* that in which the sparks flash regularly and the star is seen in advance with a train]. This time the eye, forewarned of the instant of the apparition of the sparks, does not cease to see the star, and at the instant of the explosion sees it on the line of the sparks. But it continues to see them

during a certain time during which the star advances and reaches the same position as before at the instant of the disappearance of the sparks. Thus the eye sees the star at once in all the positions comprised between the two extremes that I have just defined. For it these positions are simultaneous; their extent corresponds then to an indivisible space of time. And consequently the observer can relate the position of the star at the moment when the sparks have flashed to any one of the points of that extent.

"But it is necessary to remark besides that at the moment when the eye begins to perceive the sparks, it has still the sensation of all the positions occupied by the star before, during an interval corresponding likewise to the duration of the persistence of the luminous impression. The observer can, therefore, also relate the position of the star at the moment when he perceives the second to any one of the points of this previous extent.

"I will conclude, then, from this analysis, that the personal correction of an observer that perceives by sight an exactly rhythmed second is necessarily comprised between two limits, which are the duration of the persistence of the luminous impression taken positively and negatively."[1]

The next step is to extend the explanation to the case where the time is taken by other senses.

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[1] What he seems to mean can perhaps be shown by the figure below. The lines represent the central star with its train, the dots the occurrence of the sparks. The motion is supposed to be from right to left.

a *b*

The state of things in experiment two is represented at *a*; any position of the star in the line may be associated with the instant of the sparks. At *b* is represented the state of things in the next to the last paragraph; as before, any position of the star in the line may be associated with the instant of the sparks.

"I will remark," says Wolf:

"1st. That according to the experiments that I have cited above, my personal correction remains the same in whatever manner the perception of the second reaches me, by ear, by sight, or by touch;

"2d. That the duration of the auditory sensation being, according to the physiologists, less than 0.01 s, this duration cannot enter into the cause of personal equation, or at least cannot make it vary except in amounts less than those that we measure. . . .

"It follows from this that the cause of the personal error ought to be here the same as in the first case, that is to say, it is still found in the combination of the persistence of the luminous impression with the continuous movement of the star."

The author then repeats in substance the explanation of the positive and negative limits given above, and restates the conclusion for the case of eye and ear observations.

Wolf shows, earlier in the paper, that when the apparent motion of the star is suppressed by illuminating it with a spark from second to second, the personal equation practically disappears, and now adds a last item of evidence in showing that the duration of the after-image under conditions like those of his experiments was from 0.05 s, when the stimuli fell continuously on one point of the retina, to 0.16 s, when the image moved upon the retina. The absolute personal equation, of the kind in question, therefore should not exceed 0.16 s. In case the eye is not stationary (as has been supposed in the discussion, and as Wolf believed his own to be during the time that the star was near the wire) the explanation is still applicable; for if the eye followed the star, the images of

the wires would move upon the retina, and the after-sensations left by them would bring about the error.

I have quoted from Wolf's interpretation above because I propose to criticise it; I pass by minor matters for his cardinal experiment, experiment two. Four things contribute to this illusion: (1) the persistence of the images of the sparks; (2) the persistence of the image of the star; (3) its motion, and (4) the turning of a portion of the attention to the sparks. Assuming Wolf to be correct in implying that the attention or a part of it is turned to the sparks and remains there till the after-images have disappeared, it is clear that if the images of the sparks had no persistence, the middle point could not move during their persistence, nor be seen in advance of them; its train therefore depends on their persistence. In his further discussion Wolf seems to forget this essential point and speaks only of the train, that is, of persistence of the star's after-image. This omission lets in two errors. In the first place, if the train of star after-images depends on the persistence of the after-images of the sparks, there can be no train before the sparks flash, and consequently no associating the flash with a position of the star behind the true one, that is, no minus personal corrections. And second, if the persistence of the spark-images is essential to the illusion, it is wrong to think that the illusion is the same when the sparks are replaced by a sound of which the after-sensation is confessedly less than 0.01 s. It is, of course, easy to avoid these difficulties by making the time given to the sparks due to the inertia of attention and not to the persistence of their after-images, but that would be to surrender the point for which Wolf is contending. At the same time it is not to be denied

a priori that physiological inertia may enter to a certain extent. The fact that the eye and ear personal equation is larger for bright stars than for faint ones, as proved by Bakhuyzen,[1] could be cited in support of such a view. On the whole it may be admitted that Wolf has brought to notice a possible factor in personal equation, but it cannot be admitted that he has demonstrated the large place for it that he claimed.

Since the beginning of the year, another physiological explanation has been proposed by J. J. Landerer.[2] He finds that with very many people, himself included, there is a monocular doubling of the image of a single bright point seen at the distance of distinct vision or a little beyond, the second image being a little fainter than the original. This doubling in many is from left to right in the right eye, and from right to left in the left eye, though in some it is vertical or inclines, and in one individual was not found at all. Even when observed with a lens, the double partly overlies the principal image. In view of this, he believes "that the observation of a little luminous disk is made not on its center, but to the right or left, above or below, according to the direction of the diplopia, the eye quite naturally having regard to the center of the group that the two images form. It follows then that the efficient cause of personal equation properly so called rests in this physiological effect, or at least that this plays a preponderant role." If this is so, it is easy to calculate the personal equation for different powers of eye-piece and different declinations,

[1] See AMERICAN JOURNAL OF PSYCHOLOGY, II, 278.

[2] Comptes rendus, CVIII, 219; Feb. 4, 1889.

and in the author's case the values so found agree within a few hundredths of a second with those found in the ordinary way.

It is impossible to deny off-hand that such optical irregularities do affect observation, but after all that has been adduced in evidence of the general complexity of personal equation and the probable importance of the psychic factor in it, I cannot agree in the important rank that the author assigns to them. There is also some reason to think that some at least (in using the chronographic method) observe rather the advancing limb of the star's image than the center.

Bredichin[1] incidentally suggests a special illusion in eye and ear observations—a *sui generis* persistence of apparent motion, arising from the constant decreasing of the distance between the star and wire before the transit and the constant increasing of the distance after the transit. This would of course only fit the case of those that observe too early. Such a thing is an interesting possibility, but so far as I know there is as yet no evidence for it, except so far as it might rest on the play of attention already many times mentioned.

APPENDIX.

I add this appendix chiefly for two reasons. The first is that I wish to thank Professors Eastman and Winlock and Mr. A. S. Flint of the Naval Observatory for courtesies shown me at that institution. The second is that I may give what bibliographical references I have gathered. The list is not exhaustive. I have rather set down such references as it has seemed to me, either from having seen the articles themselves or from some other reason, might be convenient in preparing such a general sketch as has been presented. As that was confined to the form of personal equation that attends time observations, so no references are here given to any other form. The list can be enlarged somewhat, if any one desires, from Houzeau and Lancaster's *Bibliographie générale de l'Astronomie*, Vol. II, 902 ff. and

[1]Annales de l'observatoire de Moscou, II, 2nd pt., p. 69.

1685, and from Sinclair's *General Index of Scientific Papers contained in the Appendices of the Reports of the U. S. Coast Survey:* Report for 1881, app. 6, pp. 91–123. Figures for the relative personal equation, at least, can also be found in the reports of almost every determination of longitude and in the transit observations of the different observatories.

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MEMORY, HISTORICALLY AND EXPERIMENTALLY CONSIDERED.

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III.

Paramnesia.

Having brought this study of memory down to recent times, I propose, in the present section, to turn aside somewhat from strictly historical and experimental lines, to consider a class of phenomena long known, yet but little investigated. I refer to pseudo-reminiscences or the phenomena of paramnesia.[1] The importance of the subject justifies the digression.

While amnesia, including aphasia in its various forms, has long been a subject of scientific observation and study, and while the more remarkable phenomena of hypermnesia have received some consideration, the subject of paramnesia has until recently been neglected. Even Ribot in his excellent monograph on "The Diseases of Memory" considers only one form of it, *i. e.* the so-called "double memory," or feeling in a new place of having been there before. This he mentions as of rare occurrence, and says that only three or four cases are on record.[2] Sully, how-

[1] I shall use the word paramnesia, suggested by Kraepelin and formed after the analogy of paranoia, paraphasia and the like, as a general term to denote pseudo-reminiscences or illusions and hallucinations of memory.

[2] See "The Diseases of Memory," New York, 1882, p. 186.

ever, in his work on "Illusions" devotes a chapter to the subject;[1] and recently Dr. Emil Kraepelin has made an elaborate study of the more remarkable forms of paramnesia.[2]

Many writers, however, have mentioned illusions of memory. St. Augustine, so far as I know, was the first to allude to them.[3] He refers to their occurrence in dreams as a matter of common observation; and it is noteworthy that he anticipated the suggestion of Bastian and others, that pseudo-reminiscences give rise to the belief in metempsychosis.[4] Among the earlier psychologists of modern times, Hume and Hartley refer to illusions of memory as not uncommon, especially among liars.[5] More recently Feuchtersleben[6] mentions pseudo-reminiscences, calling them "phantasms of memory"; Jessen[7] refers to them, and Carpenter[8] gives some examples as "fallacies of memory." In general literature, also, there are occasional allusions to the phenomena.[9]

Among recent English writers Sully[10] has treated the subject more at length than any one else. He divides

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[1] Illusions, Ch. X, New York, 1881.

[2] Ueber Erinnerungsfälschungen, Archiv f. Psychiatrie, Bd. XVII, H. 3, and Bd. XVIII, H. 1 and 2.

[3] See my first article, this Journal, Vol. II, p. 61.

[4] Comp. Berliner Medicinisch-Psych. Gesell.; Sitzung vom 19 Dec. 1871, Archiv f. Psych. III, p. 505; also Emminghaus, Allgem. Psychopathologie, p. 132.

[5] See my first article, pp. 81 and 84.

[6] See his Principles of Medical Psych., Eng. translation, London, 1847, p. 238.

[7] See his Versuch einer wissensch. Psych. (mentioned by Kraepelin, Archiv f. Psych., Bd. XVIII, p. 409).

[8] Mental Phys., 5th ed., p. 456 seq. See also an article by Frances Power Cobbe on the same subject, Galaxy, 1866.

[9] See infra, pp. 439, 448.

[10] Illusions, Ch. X, New York, 1881.

illusions of memory into three classes according to the three things involved in a complete act of memory (we remember that a thing happened and how and when). "Thus we have (1) false recollections, to which there correspond no real events of personal history; (2) others which misrepresent the manner of happening of the events; and (3) others which falsify the date of the events remembered."[1] In his opinion these illusions of memory correspond to visual illusions. Class one is analogous to the optical illusions called ocular spectra. Such mnemonic errors may be called hallucinations of memory. Class two is like those optical illusions where a real object is seen, but its image is distorted by the refracting media between the object and the eye. Class three corresponds to erroneous perceptions of distance due to the clearness of the atmosphere and the absence of intervening objects.

Kraepelin, who has devoted his study to Sully's first class—the "hallucinations of memory"—divides these pseudo-reminiscences themselves into three classes, as follows: (1) simple pseudo-reminiscences (*einfache Erinnerungsfälschungen*), where the images of the imagination as they arise spontaneously in the mind appear as reminiscences; (2) associating pseudo-reminiscences (*associirende Erinnerungsfälschungen*), where a present perception calls up by association pseudo-reminiscences of something analogous or related in the past; (3) identifying pseudo-reminiscences (*identificirende Erinnerungsfälschungen*), where a new experience appears as a photographic copy of a former one. This division is somewhat arbitrary, and it is not always clear in which class a given case belongs; but until more cases have been

[1] Loc. cit., p. 243.

observed, and further study has been made, this division may be useful as a provisional classification.[1] The cases reported since Kraepelin's articles appeared may be arranged under his rubrics, and I shall adopt them in this article, though with a change of order and terminology.

I.—*Simple Paramnesia.*

In this form of paramnesia, the images of the imagination, as they spontaneously arise in consciousness, appear as memories. Even among normal individuals, as Kraepelin has said, pure inventions of the fancy may assume the aspect of reminiscences. This is especially noticeable among children and aged people. If complete scenes and stories are not manufactured by the imagination and made to counterfeit true memories, yet details are filled in and related with evident sincerity. More commonly, these figments of the imagination do not at first appear as things remembered, but gradually by repetition the pseudo-reminiscence is developed. This is notably the case with liars. It has often been pointed out that after a time they are liable to believe their own stories. Many narratives of adventure, of haunted houses and the like, told first for the sake of amusement and with knowledge that they were false, may have thus gradually come to be believed.

The ordinary defects of memory are well known. Sully has called attention to the fact that the common phrases of daily life—such as, "Unless my memory plays me false," and the positive assertion of one whose memory is doubted, "I know that I remember

[1] Kraepelin indeed offers this only as a provisional classification; v. op. cit., pp. 435, 436.

this, or else I dreamed it"—indicate a universal suspicion that memory is not quite trustworthy. Those whose special work is to weigh evidence are apt to put still less confidence in memory unsupported by documentary evidence. Lawyers are proverbially suspicious of their own memories, as well as those of others; and historians have to depend chiefly upon written testimony.[1]

While, apart from the cases already mentioned, normal individuals seldom or never project a whole series of imagined events into the past as memory pictures, the imagination often supplies the separate members of a remembered series. We remember certain points, the imagination fills out the picture. The following report given me by one of my students will illustrate my meaning:

"During the summer of 1888 I was requested to testify before a notary public regarding the details of an accident which I had witnessed two years previous. A large crowd had gathered in front of a prominent citizen's house to witness a display of fireworks on the fourth of July—among the rest my friend (the plaintiff in the case) and myself. My friend was struck in the eye with a ball of fire from a Roman candle. In testifying before the notary I swore that the ball of fire *had emerged from the tree where it had lodged after being discharged, and from there fell towards the earth, striking the plaintiff.* This was my impression, and I had not the slightest doubt at the time but that my statement was absolutely correct. Several other witnesses of the accident were present in the room while I was testifying, and after the testimony had been taken I found that the unanimous opinion of all the other witnesses was *that the fire-ball*

[1] Col. Nicolay is reported to have said that he and Mr. Hay received very little aid from contemporary memories in writing their history of Abraham Lincoln, and that they came to the conclusion that mere memory unassisted by documentary evidence was "utterly unreliable after a lapse of fifteen years."

did not emerge from the tree at all, but came directly from the hands of the discharger. I was much chagrined at the unanimous protest raised by the other witnesses, and had I been asked again three minutes afterwards I should have said that I could not say whether it came from the tree or not. As far as my own memory serves me I cannot say even to-day whether the ball of fire came in one way or the other. In consideration of many facts, however, I have concluded that I was mistaken."

The way the pictures of the imagination may counterfeit true memory-images will probably appear to nearly every one that is able to observe his own dreams. In dream-life, new scenes and faces, the creations of unbridled fancy, appear familiar to us. The distinction between the images of imagination and those of the memory—always indefinite—is almost obliterated. The images of the former masquerade in the dress of the latter. At least so it seems when we look back upon our dreams from waking life.[1]

Kraepelin relates the following instance from his own experience. Though never having smoked in his life, he dreamed of smoking a cigar, had clearly the taste of tobacco, and said in his dream *optima fide* that he was smoking his fourth or fifth cigar. A number of dreams containing similar pseudo-reminiscences have been reported to me, and I have noticed several among my own. One of the most noteworthy I have already reported in this Journal.[2]

This form of paramnesia is very common among the insane. Kraepelin, while observing it in other forms

[1] Of course, if one cares to argue that what seem memory-images are really what is remembered from former dreams, as in the hypnotic trance one remembers what has occurred in former hypnotic states, it will be as hard to refute him as it will be for him to prove his case.

[2] Vol. I, p. 735.

of insanity—as melancholia and mania—found it with especial frequency in *dementia paralytica*. Here the pseudo-reminiscences are very closely connected with great ideas of the present. The patient relates a mass of adventures—great journeys, meetings with noted persons, and the like. It is often hard to tell whether one is dealing with mere bragging or really with paramnesia. For a time the patient may have a vague feeling that what comes into his consciousness in this way is false, just as he often feels somewhat insecure at first about his great ideas; but, finally, doubt recedes, and the pseudo-reminiscences are assimilated as the morbid fancy presents them.

"As a separate feature," says Kraepelin, "the trouble here described is found very often in the diagnosis of paralysis, although it has hitherto been scarcely considered. A patient in Munich maintained almost daily that his wife had visited him and made him presents; another, whom I recently saw, related that the shoemaker had been there the day before and had brought clothes with him and money, also hats—thirty-five hats and a piece of gold. A third, on his entrance into the asylum, said: 'To-day is the funeral of our people; they have all shot themselves this week.' A female patient in Leubus declared: 'The woman (the attendant) sent mother coffee and bread yesterday. She is lying right over there.' In a short time, with a little attention, a great number of similar remarks can easily be collected.

"On the other hand, in contrast with this more sporadic appearance of the pseudo-reminiscence, there are cases in which the whole thought and action of the patients is greatly influenced by these morbid troubles. They no longer have any idea of what has

actually happened, but reconstruct the whole course of the day, even to details, out of pseudo-reminiscences dovetailed together."[1]

This form of paramnesia is of special interest in some cases of melancholia. The pseudo-reminiscences appear at first, perhaps, as imperative ideas, and the patient strives against them; but after a time they become established as remembered events. Many self-accusations probably begin in this way. An interesting case reported by Kraepelin may be mentioned in illustration, though the patient does not appear to have been a melancholiac. The patient related in detail and with complete conviction how she had such a delight in evil that she had destroyed a great number of wills that had accidentally fallen into her hands. Moreover, she declared that in her youth she had "numberless times" put pins into bottles of medicine that others might swallow them.[2]

It is often very difficult to distinguish a genuine pseudo-reminiscence. What appears as such may often be the memory of something dreamed or read, or the reminiscence of an hallucination of sense. The patient's lively imagination and weak judgment make it impossible for him to decide what has actually happened. A general test for determining whether one has a genuine case of simple paramnesia or the reminiscence of an hallucination of sense, a dream, or the like, has been given by Kraepelin. In the former case the train of ideas is variable—the patient seldom repeats the same story; in the latter case the essential features of the reminiscence remain constant.

[1] Kraepelin. Loc. cit., pp. 215, 216.

[2] Loc. cit., p. 211, foot-note.

II.—*Identifying Paramnesia.*

This form of paramnesia is very common. It is the so-called "double memory," or "been-here-before" feeling of daily life. Perhaps half the people one meets can tell of some experience where in new surroundings they have had the perplexing impression of having been there before. Allusions to such an experience are frequent in literature. Coleridge, Rossetti, Hawthorne, Zschocke, Dickens, and others have referred to it.[1]

So far as I am aware, the only systematic enquiry that has been made in reference to this phenomenon among normal persons was undertaken a few years ago by Prof. Osborn.[2] He distributed at Princeton and elsewhere the following question in connection with Mr. Galton's series of questions on visualization: "Have you come suddenly upon an entirely new scene, and while certain of its novelty, felt inwardly that you had seen it before, with a conviction that you were revisiting a dimly familiar locality?" This report of Mr. Osborn's study is, unfortunately, a popular one. While he refers to his correspondence as "extended," he neglects to report the number of his correspondents, or what proportion of the whole number questioned answered in some way. He reports, however, that "this question elicited affirmative replies from about one half the correspondents, cover-

[1] Hughlings Jackson cites Dickens, who describes this common experience as follows: "We have all some experience of a feeling which comes over us occasionally, of what we are saying and doing having been said or done before in a remote time, of our having been surrounded dim ages ago by the same faces, objects, and circumstances, of our knowing perfectly what will be said next, as if we suddenly remembered it."

[2] See Illusions of Memory, North American Review, May, 1884, p. 476 seq.

ing experiences of considerable variety."[1] One of the cases that he gives as representative was reported to him in the following words:

"Somewhat more than a year ago, I visited the city prison of Mazatlan, in Mexico. It consisted of a court open to the sky, on three sides of which the cells opened, the fourth being a high wall. The entrance was by an arched passage-way, with three barred gates. The court paved with cobbles, the entrance, the several rooms, every surrounding internally, seemed as familiar to me as home. Not so with any portion of the exterior. Yet I had never been within three thousand miles of the place until this journey."

Most of the cases of this form of paramnesia so far observed seem to have been of normal individuals. I do not feel sure, however, that Kraepelin is right in saying that it "belongs almost exclusively to normal life." Further observation may show that it occurs as frequently, or even more frequently, in pathological cases. Certainly it is not uncommon among the epileptic;[2] and the cases already reported[3] show that it also occurs in other forms of insanity, as will appear in the following pages.

The first pathological cases reported, so far as I know, were observed by Neumann.[4] He looked upon the phenomenon as a sort of mental mirage, and called it *Empfindungsspiegelung*. Of the two cases observed by him, one was an adolescent; the other an epileptic woman. The former when brought to the asylum

[1] Loc. cit., p. 478.

[2] See Hughlings Jackson: "Intellectual Aura," Brain, July, 1888. See also infra, p. 442 seq.

[3] These cases are mentioned by Kraepelin, loc. cit., p. 428. See also the Autobiography of a Paranoiac, by Dr. Peterson, this Journal, Vol. II, p. 198; other doubtful cases have been reported by Jensen and others.

[4] Lehrbuch d. Psych., pp. 111, 112.

maintained that he had been there before, that he had talked with the physicians, that the same things had been said to him, that he had before had the same room, that he had eaten the same food, etc. In case of the latter, the paramnesia became so extreme that, when reading history, the patient thought that she herself had experienced the events related. In both these cases the illusions caused excitement and anxiety. Afterwards cases were reported by Jensen[1] and Sander;[2] and one of the most remarkable cases on record was observed by Dr. Pick.[3] The following account condensed from the original report will give the most interesting features of the last mentioned case:

The patient was a young man of considerable intelligence and of a very good memory. His illusions began in a marked degree when he was about 23 years of age. As the psychosis developed, he had delusions of persecution and aural hallucinations, and was brought to the asylum. In the diary that the patient kept he reported that, on the second day of his stay in that institution, it seemed to him that he had been there before. The patient kept quiet most of the time, and seldom spoke, except of his illusions of memory and the insane ideas connected with them. From reflection on his illusions the patient concluded that he must have a double life, made up of recurring periods of similar events.

The chronic form that the false memory assumed will appear from the following account given by the patient: "The first clear experiences of a double life I had in the autumn of 1868 at St. Petersburg. But these occurred only occasionally; for example, on visiting places of amusement, or at great festivals, and when meeting persons, the accompanying circum-

[1] Allgem. Zeitschr. f. Psych., Bd. XXV, Supplement Heft, S. 57 seq.

[2] Archiv f. Psych., Bd. IV, S. 244 seq.

[3] Archiv f. Psych., Bd. VI, S. 568.

stances seemed so familiar to me that I firmly believed that I had already been in the same place and had met the same persons under just the same circumstances, at the same season of the year, in the same weather, the men standing in the same places, in just the same manner, and even precisely the same conversation occurring. . . . After 1870 almost every piece of work that I attempted in my business seemed familiar to me, as if I had already done the same in former years, in the same order and under exactly the same circumstances; not only this, but even every chance meeting with any one, and in general everything that occurred around me, brought this feeling. It came to me sometimes at the moment of perceiving a thing, or after some minutes or hours, frequently not until the next day."

A similar case is reported by Forel.[1]

The patient was a young merchant, of good education, like Pick's patient, brought to the asylum with delusions of persecution. On entering the asylum he maintained that he had been there a year before, and he recognized everything in the manner described above. From these false memories the patient got the idea that he had actually lived through his present experience before under similar circumstances, and that on occasion of his former entrance into the asylum and dismission from it he had been stupefied, and thus robbed of the immediate recollection of those events. Now as he saw and experienced all these things again, he began to recall them. Hence the patient believed that he was a year further on in time, and he persistently wrote 1880 instead of 1879. To corroborate his memory he was ready to refer to the asylum reports of the previous winter. This patient's paramnesia continued after he left the asylum.

Kraepelin cites two cases of epilepsy where the patient had this form of paramnesia.[2] Hughlings

[1] Cited by Kraepelin, loc. cit., p. 430 seq.

[2] Loc. cit., pp. 428, 429. One of Neumann's cases was an epileptic. See his Lehrbuch der Psychiatrie, p. 112. See also Jensen's report, loc. cit., p. 57; and Sander, loc. cit., p. 252.

Jackson[1] has reported several cases where, in the "intellectual aura" or "dreamy state," false memories occurred. One of the most important of his cases is that of a highly educated physician who is subject to attacks of *petit mal* and *haut mal*. In his report of his own case this gentleman mentions illusions of memory in the initial stages both of *petits maux* and *hauts maux*. Speaking of his mental condition in the former, he says:

"In a large majority of cases the central feature has been mental and has been a feeling of recollection, *i. e.* of realizing that what is occupying the attention is what has occupied it before, and indeed has been familiar but has been for a time forgotten, and now is recovered with a slight sense of satisfaction, as if it had been sought for. My normal memory is bad, and a similar but much fainter feeling of sudden recollection of a forgotten fact is familiar. But in the abnormal states the recollection is much more instantaneous, much more absorbing, more vivid, and for the moment more satisfactory, as filling up a void which I imagine at the time I had previously in vain sought to fill. At the same time, or perhaps I should say more accurately, in immediate sequence, I am dimly aware that the recollection is fictitious and my state abnormal."[2]

In another case reported by Ferrier a woman had attacks of *le petit mal* that were divided into three distinct stages, of which "the first stage is a dreamy state or reminiscence, in which everything around her seems familiar or to have happened before."[3]

Several years ago, another physician, subject to attacks of epilepsy, suggested that this form of paramnesia might serve as prognostic of epilepsy. In his

[1] Loc. cit.

[2] Loc. cit., p. 202. This is not clearly a case of this form of paramnesia, but is interesting on account of its connection with epilepsy.

[3] Cited by Jackson, loc. cit., p. 198.

own case he came to treat the experience "as an indication for immediate rest and treatment." Apropos of this case Hughlings Jackson says, "I should never, in spite of Quaerens' case, diagnose epilepsy from the paroxysmal occurrence of 'reminiscence' without other symptoms, although I should suspect epilepsy if that super-positive mental state began to occur very frequently, and should treat the patient according to these suspicions were I consulted for it."[1] He emphasizes, however, the advantage of noting this phenomenon as a possible symptom of epilepsy.

Similar phenomena seem to occur frequently in dreams. Probably almost every one will find instances by noticing his own for a time. Several cases have been reported to me. The following, given me by one of my students, will serve as an illustration:

"I remember that once in a dream I entered a second-hand book-store. The place was perfectly familiar to me, and I spent some time there looking at books and talking to persons I knew. On awaking I knew that I had never been in any such store. In the dream I did not recognize it as a *new place* that I was remembering, but only on waking."[2]

An Italian psychologist[3] says that he has often observed this form of paramnesia in himself, and he reports a dream containing a similar illusion. The following is the substance of his report:

"Last night I dreamed of having occupied with my family a portion of a certain house situated in some city. While discussing with my wife the arrangement of the furniture and the use of the different rooms, I remembered with perfect clearness having lived in the

[1] Loc. cit., p. 186.

[2] Comp. a case reported by Kraepelin, loc. cit., p. 413.

[3] Francesco Bonatelli: Il fenomeno della ricordanza illusoria. Rendiconti della Reale Accademia dei Lincei, Vol. IV, fasc. 4.

same apartment several years before, and spoke of the arrangement of our furniture at that time. The dream was so impressive that upon waking I had at first no doubt that I was recalling what had actually happened. On reflection, however, I was convinced that my recollection was false."

The writer seems more than once to have dreamed of this apartment, and to have had similar illusions of memory.

By considering the cases cited it will be seen that they differ in one important point. In case of the normal persons the illusion is immediately corrected (although it is possible that other cases occur where the illusion is not corrected and hence not observed). In clearly pathological cases like those reported by Pick and Forel, and also in dreams, the illusion is not corrected. This form of paramnesia seems to occur most frequently among young people and those gifted with vivid imagination,[1] and at times of fatigue or excitement.[2]

Kraepelin distinguishes the following characteristics of this form of paramnesia.[3] In the first place, the whole picture of the present moment is recognized as an accurate copy of the supposed original in the past. In most cases the illusion appears suddenly and vanishes suddenly. There is a vague feeling that one knows what is to happen next. Finally, there is often a vague feeling of uneasiness or anxiety, due to the vain attempt to comprehend clearly the obscure ideas floating before the mind.

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[1] This is the opinion of Kraepelin, loc. cit., p. 410, and the cases I have studied corroborate this view. The number of cases reported, however, is too small to warrant a positive statement.

[2] Anjel, Archiv f. Psych., Bd. VIII, p. 57 seq. See also Bonatelli, op. cit.

[3] P. 424 seq. Sander mentions substantially the same characteristics, loc. cit.

Many hypotheses have been invented to account for this phenomenon. Wigan noticed this form of paramnesia in himself, and explained it in accordance with his theory of the dual nature of the brain. In his opinion, on occasion of such an illusion, at first one hemisphere functions alone, then the other wakes up, and to their fused consciousness the vague impression of the former is a recollection. As the original impression was too indistinct to be fairly fixed in memory, we have no means of localizing it definitely in the past; thus it may seem to have occurred years before. Jensen[1] and Wiedemeister[2] have based their explanation upon the same theory.[3] Anjel[4] has propounded the ingenious theory that in such illusions the processes of sensation and perception which usually overlap become separated. The mind, on account of fatigue, is unable to perceive (or, to use the modern term, to apperceive) the sensation when it occurs; and, when the tardy process of perception does occur, the mind is unable to distinguish this fading sensation from a reproduced impression. In proof of this he states that he has always found that these illusions occur when one is fatigued or when the attention is momentarily distracted. He cites the case of a lawyer who, in the strain of a difficult lawsuit, was suddenly seized with this form of paramnesia. Here the illusion was the premonition of nervous disease. Anjel

[1] See loc. cit., also Archiv f. Psych., Bd. IV, S. 547 seq., where he cites in support of this view the case of a patient subject to attacks of migraine in the left side of the head. The patient had this form of illusion in the state preceding an attack.

[2] Allgem. Zeitschr. f. Psych. Bd. XXVII, p. 711 seq. He calls this phenomenon, inaptly enough, "double consciousness."

[3] Dr. Maudsley also favors this theory. See The Double Brain, Mind, Vol. XIV (No. 54), p. 187.

[4] Loc. cit.

noticed similar effects of fatigue in his own experience. After spending hours in the Venetian art galleries, he suddenly felt that he had already seen the paintings before him, although he knew that this was impossible.[1]

In opposition to these theories, Jessen,[2] Sander,[3] and others have held that there is a vague recollection of some kind, upon which the pseudo-reminiscence is based. According to Sander, this phenomenon is a result of false association. Some similar scene has been witnessed, imagined, or dreamed in the past, and part of the elements of the situation are truly remembered.[4] Sully[5] and Buccola[6] also have maintained that the illusion often arises from remembering the events of dreams and localizing them in our waking life. Emminghaus thinks that we identify a present situation with a former one in some respects similar, because,

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[1] A fellow-student of psychology suggests a theory that is quite the obverse of this. He has often observed this form of illusion in his own dreams, and thinks they generally occur in morning dreams. The over-rested condition of the nerve centers may, he thinks, explain this phenomenon. When we see a strange object, its unfamiliar aspect is largely due to the difficulty we find in apperceiving its characteristics. The process of becoming acquainted with a thing consists in making the act of apperception easy. Hence, when the brain centers are over-rested, the apperception of a strange scene may be so easy that the aspect of the scene will be familiar. The fact observed by Anjel that this illusion is apt to occur in conditions of fatigue does not necessarily conflict with this explanation. In the cases observed there may have been an abnormal ease of apperception due to hyperaesthesia induced by the fatigue. It may be added that Bonatelli thinks that illusions of memory occur in states of unusual nervous irritability. Such, in his opinion, would be the condition in vivid dreams and in the unusual circumstances of journeys and the like. For his own theory see op. cit.

[2] Op. cit.

[3] Loc. cit., p. 252.

[4] Sander admits, however, that this explanation will not suffice in all cases.

[5] Op. cit., p. 274.

[6] Le illusioni della memoria. Rivista di filosofia scientifica, 1883, II, pp. 2, 6. Cited by Kraepelin.

owing to a too rapid flux of thought, we apperceive the points of resemblance and neglect the differences.

Kraepelin maintains that this theory of a basis of true recollection does not solve all the difficulties, and that it can only claim to be a hypothesis. He rather favors the view that at least in such cases as those reported by Pick and Forel, the false recollections are created out of whole cloth by the imagination.[1]

Cases enough have not yet been reported to furnish data for a satisfactory hypothesis. It may, however, be safely said that in most cases among normal individuals the false recollections are distorted memories of actual events. They are illusions, not hallucinations. We have seen or imagined something similar. That Buccola's explanation may often be the correct one is made probable by the observations of Radestock and others.[2]

Hawthorne has given, in "Our Old Home," an excellent illustration of the way a vivid imagination may furnish material for an illusion of this kind.[3]

After describing his visit to Stanton Harcourt, he gives an account of the old kitchen of the castle, with its huge fireplaces, blackened walls, and conical roof seventy feet above the hearth, and adds: "Now—the place being without a parallel in England, and therefore necessarily beyond the experience of an American—it is somewhat remarkable that, while we stood gazing at this kitchen, I was haunted and perplexed by

[1] Op. cit., p. 424 seq.

[2] Radestock in *Schlaf und Traum* relates that when keeping a record of his dreams he often felt that he had seen something before without being able to tell when or where. On turning to his record, he generally found that he had dreamed something similar. One of my students reports a similar experience. See also Carpenter, Mental Phys., 5th ed., p. 456.

[3] This instance apparently lacks some of the elements of complete identification upon which Kraepelin insists, but it is nevertheless an instructive case.

an idea that somewhere or other I had seen just this strange spectacle before. The height, the blackness, the dismal void before my eyes, seemed as familiar as the decorous neatness of my grandmother's kitchen."[1]

Hawthorne himself discovered the cause of his illusion, and reports it as follows: "Though the explanation of the mystery did not for some time occur to me, I may as well conclude the matter here. In a letter of Pope's, addressed to the Duke of Buckingham, there is an account of Stanton Harcourt. . . . It is one of the most admirable pieces of description in the language, playful and picturesque, with fine touches of humorous pathos, and conveys as perfect a picture as was ever drawn of a decayed English country-house; and among other rooms, most of which have since crumbled down and disappeared, he dashes off the grim aspect of this kitchen. . . . This letter, and others relative to his abode here, were very familiar to my earlier reading, and remaining still fresh at the bottom of my memory, caused the weird and ghostly sensation that came over me on beholding the real spectacle that had formerly been made so vivid to my imagination."[2]

III.—*Suggested or Associating Paramnesia.*

In this form of paramnesia the pseudo-reminiscence is analogous or related to a present experience. An actual impression suggests an illusion or an hallucination of memory.

Mere illusions of memory suggested by present impressions are common in normal life. As we apperceive any object or event through the media of the feelings and ideas in consciousness at the moment, and thus no two of us apperceive the same thing in the same way, so in recollection each apperceives the past from the standpoint of his present state of consciousness, and the latter bears its part in determining what

[1] Our Old Home, p. 213.

[2] Op. cit., pp. 213, 214.

the resulting recollections shall be. We remember only main features of an event anyway, and the imagination fills in the gaps. Thus remembrance is never a true reproduction of reality. It is always more or less an illusion. At best it is an approximation to the truth. How near an approximation depends largely upon the apperceptive mood of the moment.

Among the insane who are subject to this form of paramnesia, any present impression may be the impulse to a pseudo-reminiscence. For example, when one of Kraepelin's patients met any one, he was liable to have a pseudo-reminiscence of having done something or having been somewhere with that person.

Kraepelin has called attention to the necessity of distinguishing between pseudo-reminiscences and certain illusions due to defective observation.[1] A patient may call a person by a wrong name, either on account of a pseudo-reminiscence connected with the person, or because of false perception due to defective vision, inner voices, revelations and the like. In the former case the memory-picture is distorted to resemble the present impression. In the latter, the present impression is remodeled to fit the memory-image.

The more extreme forms of suggested paramnesia, such as may be called hallucinations of memory, possibly occur sporadically among normal individuals. No very satisfactory cases, however, have yet been reported.[2] In dreams, however, they are probably not uncommon. I take a simple instance from my own experience. The dream occurred years ago before I had anything to do with psychology, yet it made such an impression upon my mind that I have never for-

[1] Loc. cit., p. 230 seq.

[2] But see infra, pp. 462–463.

gotten it. I dreamed of receiving a postal-card, and at once remembered writing a letter, to which the card before me was an answer. Upon awaking I knew that I had never written such a letter. Here was a pseudo-reminiscence suggested by a present impression, but with apparently no basis whatever in fact. Two cases have been reported to me by a friend, himself a psychologist. The first dream contains a simple pseudo-reminiscence as well as one of the class under consideration. The part of the dream relating to the latter is reported by him as follows :

"As I went down a street in Baltimore (not, I think, any real one), I had a distinct recollection of being told by Mr. C. that this was one of the aristocratic streets in old times." While the memory of a portion of the dream was somewhat vague, my correspondent felt "clear and certain" upon the point in question. "I distinctly remember the thought," he says, "'This is the street I have been told about,' while I was really told about none. I even believe now, though I naturally cannot be absolutely certain, that this thought was accompanied by a mental picture of the telling, such as I sometimes experience when I remember such things very vividly."

The notes on the second dream were made immediately upon waking, and the full report written up in a few hours. It likewise contains two pseudo-reminiscences; I quote, however, only the portion of the report that concerns us here.

"In my dream I enter a room and see at the supper-table two young fellows. One of them tells me that Mr. B. has been arrested at the South (Ky.), and been refused extradition from the State because he has at one time had a 'warrant' served on him here for challenging a man's vote.[1] On hearing this, I have the

[1] My correspondent's legal knowledge in dreams seems to be as erratic as his memory.

recollection quite clearly of having heard the same story (at which of course I was much surprised) some time before from Mr. B. himself. The only event in waking life having any relation to this pseudo-reminiscence is, that Mr. B. actually did tell me not long since of a strange law in Virginia or North Carolina; nothing, however, having any relation to the subject-matter of my dream."

A similar dream is reported by one of my students.

In his dream he ascended a mountain in the Blue Ridge. "From this place," he continues, "I distinctly saw the farm-house where I am accustomed to stay, exactly as it actually exists. In one of the fields I thought carpenters were at work preparing fair-grounds, all the details of which I can remember—race-track, flying-horses, etc. I thought then that I remembered having been told that that field was to be sold for just such a purpose. In reality nothing of the kind is the case. My friend never had an idea, that I know of, of selling one of his fields, much less selling one for a fair-ground."

The pseudo-reminiscences in the following dream, reported by the American Society of Psychical Research, are closely related to the class under consideration:

"I will tell you a *dream* which I had a few nights ago, which possibly may be of interest in connection with these questions. My friend, C. W. B., visited us recently, and spoke with Mrs. A. and me repeatedly about his several trips to Europe, describing especially his experiences in Spain during his last trip.

"A few nights later, I dreamed of looking over with him a lot of large photographs of scenes in Scotland, which he took when we were in Scotland together; many of the photographs showing me very plainly in various attitudes with different groups of people. Now, Mr. B. and I were never in Europe together, and I was never in Scotland in my life. Yet as each photograph was shown, I felt all the keen delight of recognition of well-remembered scenes, and frequently exclaimed, 'How well I remember that!' or 'Don't you remember

the day we were there?' etc. I can still remember the features of several of the pictures, parks, grounds, etc., as they appeared in these photographs, and my keen interest in seeing them *again*, and my memory of many incidents and particulars of our being at these places together at some former time. I then dreamed, with the well-known inconsistency of a dream, that in the case of one place Mrs. A. had been with me, and I turned and asked her if she did not remember the day we were there, and what the old lady in charge of the place had said to us.

"If I could in this dream have so strong a sense of having been in the photographed places before that each brought up a flood of remembered experiences, all of which were—pictures and remembrances—the coinage of the dream at that moment, is it not likely that this is a power which the mind sometimes exercises in waking hours?"[1]

Kraepelin reports two remarkable cases of paranoiac patients, who were subject to pseudo-reminiscences of such an unusual nature that they deserve special mention.

The first is the case of a servant-girl, twenty years of age, subject to periods of excitement and depression, and the victim of hallucinations, the disease finally developing into erotomania. At times she had the illusion whenever anything occurred that her lover had foretold the event. "She related that she had met a beautiful wagon which he had foretold that he would send to her. Gravel had been emptied on a road and a bank formed. Even this her lover had predicted. Likewise he had told her that he should take her to a hospital, and further, that a new superintendent would come to the asylum. These predictions never occur to the patient *until she sees the things concerned, or until the events have occurred.* Then she suddenly remembers that some time before she heard her lover speak of them. Beforehand she knows nothing about them, but believes that she might really

[1] Proceedings of the American Society of Psychical Research, Vol. I, No. 4, p. 567.

know." When it was announced to the patient that she was to be removed to another asylum, she at once thought that she remembered the very words with which her lover had predicted this event.[1]

Kraepelin's other case is one of the most remarkable on record.

The patient was a merchant 33 years of age. For some 12 years he had shown symptoms of insanity. As the psychosis developed, he thought the *Fliegende Blätter* contained references to him, and that *Ueber Land und Meer* caricatured him. These illusions did not occur when he read the papers, but after some days the thought suddenly came to him that certain passages referred to him. He remembered even on what page a passage stood. Never finding the sentences remembered on turning to the papers, he got the idea that the editions in question had been withdrawn and that others had been substituted. After entering the asylum, the patient declared that some weeks before he had heard an account of all his companions, and that he had read in the newspaper about the management of the asylum, even in its minutest details. He had given no heed to these reports at the time. Not until he saw the people concerned and the places referred to, did it occur to him that he had already been told about them or that he had read of them. Then he reproduced in detail the circumstances and order of the former experience. In short, almost every striking new impression was the occasion of a pseudo-reminiscence. For example, when a murderer was arrested in Munich, he remembered at once that some time before he was asked whether he had ever been on the street where the arrest was made. The patient claimed that he had an unusually good memory (in fact the patient's memory for actual events was good), and his paramnesia extended to minute details. For example, he remembered that some months before he had read in the *Fliegende Blätter* a detailed account of the furniture of the dining-room at the asylum. After a time the patient's false memory took a peculiar turn. He found that views

[1] Loc. cit., p. 397.

which he expressed in conversation in regard to the Pope, social reform, and the like, were printed almost verbatim in the newspapers. In the *Fliegende Blätter* he found jokes that he had formerly related and pictures that he had designed. In number 2022 there were eight of his own jokes; and he remembered that he had formerly said in answer to a question relating to the matter, that they would appear in a number that contained three two's. Finally it occurred to him that many of his thoughts had been previously communicated to him. Some verses even that he composed upon his fellow-patients were predicted to him. And he recollected that he had composed the obituary notice of the wife of a State minister a year before her death, on occasion of the illness of his own wife. The patient liked to spend his time thinking over the experiences of his life, and the abnormal activity of his mind is well shown in what he says of himself, "When I begin to compose, then one thing suggests another; it is the veriest Huns-battle of the mind."

Dr. Orschansky has reported a case that certainly is closely related to this form of paramnesia[1]; although, for some reason that is not clear from the published report, he thinks it does not belong here.

The patient was a young Russian student who had been expelled from the university for engaging in a student riot, and soon after became the victim of delusions of persecution. The following are extracts from his stereotyped form of conversation with the physician:

"Then you are afraid of the treatment?—Yes. It was prophesied to me three years ago, that after three years Dr. O., dressed in a blue coat, just like the one I then wore, should treat me with electricity, but without success.—But what if I treat you hydropathically instead of with electricity?—That too, I think, was prophesied to me. . . . Everything that was to happen was prophesied; that at the railway station in Kursk I should see a waiter handing out tea to the passengers at the buffet, and that this should be no other than

[1] Archiv f. Psych., Bd. XX, H. 2, S. 337 seq.

Alioschka, the Moscow executioner. On the way I saw a disguised woman. I believe it was my wife; this too had been prophesied to me. Here I am watched by the Princess T., who is dressed as a servant. The same person follows me everywhere. Sometimes she is blonde, again brunette, alternately young and old, sometimes a man, and again having the form of a woman. This also was prophesied to me.—Was anything else prophesied to you?—Oh yes! It was prophesied that the doctors in Charkow would declare me insane, that then a dispute would arise between them and the Moscow physicians, that the latter would declare me sane and win the day."

While too few cases have thus far been reported to admit of any very positive conclusions in regard to the cause of paramnesia and its relation to normal and abnormal mental activity, nevertheless one thing seems tolerably clear, namely, that the pathological cases of paramnesia are extreme forms of what occurs in normal life. Here, as is usually the case in psychiatry, the beginnings of pathological mental activity are found in normal life; and further study of paramnesia will probably furnish admirable illustration of the way that normal mental activity passes over into abnormal.

While the more remarkable forms of paramnesia cannot yet be satisfactorily explained, the relation of false memory to ordinary uncertainty of memory is, in most cases, easily traced. It may be seen from the most commonplace illustration. Try to recall all the events of yesterday in the order of their occurrence. The first and most serious difficulty you will encounter will doubtless be in localizing the details in their exact order in time. As I write, I try the experiment. Yesterday I went to Washington and studied at the Surgeon-General's Library. Plenty of things are re-

called—even minute details. But did my friend say this before or after he said that? Did I write this note before or after I read the article in the *Lancet*? Did I examine the Japanese masks in the National Museum before I saw the Egyptian mummy? These and similar questions I cannot answer.

This, however, is not the only difficulty. I am not quite sure whether certain trivial things happened or not. For example, my friend told me what he ate for lunch. It *seems* to me that he said he had toast, but I am not sure. Now, if circumstances had happened to make it very important that I should testify upon this point—for example, suppose my friend had been poisoned—I might possibly by thinking intently, by calling to mind different kinds of food and by other devices, recall what my friend said. This recollection might come like a flash with an unmistakable clearness. It is more likely that I should gradually come to feel that the particular amount of familiarity that the mental image on trial came to have, and its congruousness with the mental picture of the scene when my friend told about the lunch, would finally appear to me sufficient evidence of its genuineness as a truly remembered event. It is clear that an error here is easy. That some persons would approve such a group of presentations upon less evidence than others is clear. That under stress of a necessity to support certain interests I might approve to-day what to-morrow I should deem sustained by too little evidence, is not difficult to believe.

The distinction between what is clearly remembered and what is imagined ordinarily is definite enough. There is, however, a doubtful borderland where it is difficult to tell what we remember. The acts of repro-

duction, recognition and localization in the past ordinarily occur so easily and rapidly that we fail to note what really happens; it may be that some of the processes are abridged or occur unconsciously. But when in doubt whether we remember or not, the intellectual process is essentially this: first, an act of reproducing a group of presentations; second, an act of judgment deciding whether the reproduced group has a sufficiently familiar aspect to make good its claim to recognition; third, localization in the past, if the judgment approves. Setting aside the errors in localization, it is plain that pseudo-reminiscences may arise from either of two causes—either the given group of presentations may occur to the mind with a factitious air of familiarity, or the critical function of the mind may be so impaired that the given group is recognized upon insufficient evidence. As has been shown above, a group of presentations may acquire a factitious aspect of familiarity from our having seen, imagined or dreamed something similar. And it is noteworthy that pseudo-reminiscences seem to occur most frequently among those whose judgments are weak—the young, the aged, and those whose minds have been weakened by disease.

Some of the cases recorded suggest that the phenomena of paramnesia, when carefully studied, may be helpful in the diagnosis and prognosis of disease. Kraepelin found simple paramnesia a very characteristic accompaniment of *dementia paralytica*.[1] A good part of the cases reported, both of simple and identifying paramnesia, have been epileptics. A symptom of such frequent occurrence (although it does occur in

[1] See loc. cit., pp. 218, 219.

normal life) should be noted, as Hughlings Jackson has urged. How closely this phenomenon may be connected with the disease appears in one of the cases reported by Jensen. The patient came to him one day with the following complaint: "Doctor, I feel so very strange to-day. When I stand now like this and look at you, then it seems to me as if you had stood there once before, and as if everything had been just the same, and as if I knew what was coming; and when I think about it, I get so frightened [*schucherich*, a word used by the patient to designate the attacks], and I go back and turn around; and when it is over, the whole thing seems so ridiculous—and it has been so all the time to-day—I don't know what ails me."[1] On finishing these words the patient immediately had an attack.

The medico-legal aspect of this subject is of the most practical importance. The more common forms of paramnesia described above show that it is not impossible to manufacture testimony. A member of the bar tells me that this is actually done in some cases, the method employed being somewhat as follows. The witness is a person of deficient memory. It is desirable that he should testify to the occurrence of a certain event. The lawyer asks the witness if he remembers this event. The reply is, No; and nothing more is said. But the idea of the event has been suggested to the mind of the witness. In a few weeks the lawyer repeats the same question, and again receives a negative answer. But after a few similar experiments the witness becomes uncertain whether he remembers the event in question or not. He begins to

[1] Allgem. Zeitschr. f. Psych., Bd. XXV, S. 59.

think that he does. The images of the imagination suggested by the lawyer's questions loom up vaguely in the mind, the memory is confused, and in a few months the lawyer, if skillful, may develop a pseudo-reminiscence so strong that the witness will give the desired testimony with complete sincerity. Of course this cannot succeed with persons of strong memory and critical judgment, but with children and aged people it may not be difficult.[1]

The false testimony of children has received some study. A. Motet[2] reports four cases from his own observation and cites others; among the latter is the famous case of Moritz Scharf, who falsely testified that his own father had committed a most horrible crime.[3] In Motet's opinion, children with abnormally developed imaginations often fail to distinguish what has actually happened from what has been imagined, read or suggested by others. Thus false testimony may be given in all innocence.

Nothing, as Motet says,[4] is more effective than a child's story of the details of a crime of which he pretends to have been a witness or a victim. The child's

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[1] The uncertainty of human testimony was notably illustrated a few years ago in the case of the Bell Telephone Co. vs. the People's Telephone Co. The chief point at issue was whether Daniel Drawbaugh had a telephone in his shop prior to 1876. Several hundred witnesses gave testimony bearing directly or indirectly upon this point. The honesty of most of the witnesses seems to have been admitted, yet evidence offered by one side was generally refuted by testimony from the other. The Supreme Court divided upon the case, and the seven thousand printed pages of evidence in the suit seem rather to prove the fallibility of human testimony than anything else. See article on Daniel Drawbaugh, by H. C. Merwin, Atlantic Monthly, Sept., 1888.

[2] Les faux témoignages des enfants devant la justice. Paris, 1887.

[3] See L'affaire de Tisza-Eszlar, Revue des Deux Mondes, August 1, 1883.

[4] Op. cit., pp. 7 and 8.

naiveté adds to the interest and elicits confidence. His hearers urge him on by their sympathy. Parents, friends, and neighbors accept the account, true or false. They suggest new details and fill up the gaps in the story. The child's uncritical mind assimilates these details, repeats the story without variations, and makes his accusation before the magistrate with an apparent accuracy that is most telling.

Finally, the study of paramnesia is of interest in relation to so-called cases of telepathy. As an explanation of some of these cases, Professor Royce has formed the following hypothesis :

"*In certain people, under certain exciting circumstances, there occur what I shall henceforth call* PSEUDO-PRESENTIMENTS, *i. e. more or less instantaneous and irresistible hallucinations of memory, which make it seem to one that something which now excites or astonishes him has been prefigured in a recent dream, or in the form of some other warning,* although this seeming is wholly unfounded, and although the supposed prophecy really succeeds its own fulfilment."[1]

Professor Royce argues that the pseudo-presentiments described above under the third form of paramnesia "occur sporadically among the sane, even as they occurred persistently in Kraepelin's young patient." He cites some dozen cases of dreams involving presentiments that in his opinion may be explained in this way. In these cases there is no satisfactory evidence to show that the dream was related to any one before the predicted event occurred ; and the events were prefigured with considerable minuteness of detail. This hypothesis cannot, of course, be

[1] Op. cit., p. 366.

easily verified in any given case. It gains *a priori* probability, however, from the phenomena of paramnesia as illustrated in this article. That it may be a very plausible explanation will appear from the following case (not unlike some of Professor Royce's) that has just come to my knowledge.[1] My informer is a well-known citizen of Baltimore. I consulted him personally, and report the case as nearly as I can in his own words. This is his story somewhat abridged:

"From boyhood I have had presentiments. They generally come when I first awaken in the morning. I hear an inner voice telling me what is to happen. Upon investigation I always find that the presentiments are corroborated in some way by facts.

"About four or five years ago a very remarkable event occurred. My place of business at that time joined my living apartment. I could look from my office through a glass door to a wooden door opening into the parlor some twenty-five feet away. While at work in my office one day I looked through the glass door toward the parlor opposite. The wooden door was closed, but *through* this door I distinctly saw a man passing through the parlor. I saw the whole parlor and everything about the man, his size, clothes, hat, beard—all distinctly. At once I started to go to him and see what he was doing. But, very singularly, as soon as I started I forgot what I was going for, the vision went out of my mind, and I went to my wife's room adjoining the parlor to look for her. Not seeing her, I was returning to the office when some power took me by the shoulders, turned me around, forced me back into my wife's room and up to a trunk in one corner. Here I found a man trying to open this trunk; and it at once flashed across my mind that this was the very man I had seen in the vision. The man feigned drunkenness, and I made him leave the house. When my wife came in soon after, I told her that I had looked for her and found a man instead. On her

[1] Compare a dream reported by the Eng. Soc. for Psych. Research, Proceedings, Dec. 1888, pp. 316, 317.

way to the house she had found a bit of cotton from her jewelry box, and she at once guessed that this man had stolen her jewels. This proved to be true, though I could hardly believe it at first, because, as I told my wife, there was not time for him to do so between my seeing him in the parlor and the time I found him at the trunk."

My informer is very positive about the vision. "No power under God's heaven," he says, "neither you nor anybody else, Doctor, can convince me that I did not see just these things. I saw the man, but I did not see him. I saw him in my mind. I can account for it only by thinking that it was the work of some higher power that wished to warn me of the robbery." "How," I asked, "do you account for the remarkable fact that after starting towards the man you immediately forgot the vision?" "I can account for it only in this way," he replied; "if I had gone into the room at once and found the man, I should have caught hold of him in a rage, and one of us would have been hurt; the higher power wished to protect me from this. Hence I forgot what I started for."

The length of time since this event occurred makes the record less trustworthy.[1] But granting that the account is substantially correct, an explanation on the theory of pseudo-presentiment is very plausible. That my informer's mind is fertile soil for unusual experiences is evident from the general tone of his account, that he was agitated at the sight of the burglar is a natural inference, that in the mental turmoil of the moment he might have a pseudo-reminiscence seems possible, but that he should see such a remarkable vision and at once forget it is almost unaccountable.

It has been the purpose of this paper to illustrate the different forms of paramnesia and to show the bearings of the subject rather than to offer theories. In

[1] The wife confirms the telling of the story to her soon after the alleged events occurred.

conclusion I have only to express the hope that this article may stimulate others, especially alienists, to record cases of paramnesia that may come under their observation. Little is known about the more remarkable forms of paramnesia. There are as yet no data for determining how common pseudo-reminiscences are either among the insane or among normal individuals. But that the subject is interesting and practically important is clear from the cases already reported.

PSYCHOLOGICAL LITERATURE.

I.—NERVOUS SYSTEM.

Zur Geschichte des Gehirns, sowie central und peripherischen Nervenbahnen beim menschlichen Embryo. WILHELM HIS. XIV Band d. Abhandlungen d. Koenigl. Saechsischen Gesellschaft der Wissenchaften, No. VII, 1888.

Die Entwickelung der ersten Nervenbahnen beim menschlichen Embryo. Uebersichtliche Darstellung. WILHELM HIS. Arch. f. Anatomie u. Physiologie, 1887.

Under the second title His has given a condensed presentation of his view regarding the development of the nerve tracts in man. The first paper is more elaborate, and an idea of the work can be best gotten from considering certain portions of that. In the study of such questions, schematizing is the great pitfall that the author must avoid, according to His, and certainly he, as much as any one, has developed the technique by which such a danger may be escaped. The artistic figures which accompany the paper are actual reconstructions from the sections, accurate in every detail, for where the sections cease to be clear the figures stop.

It is the changes occurring between the end of the first and end of the second month which are here considered. The opening section deals with the changes in the form of the brain up to the end of the second month, the relative development of the different vesicles and the variations in flexure being shown by illustrations. At the end of this period the hemispheres have just covered the interbrain, and the cerebellum is commencing to grow out. A cross-section of the brain tube in the earlier stages is essentially like that of the spinal cord. It is laterally compressed, with thick side walls connected ventrally and dorsally by two thinner layers of cells. The dorsal wall is the dorsal plate (*Deckplatte*); the ventral, the ventral plate (*Bodenplatte*). The lateral walls on each side are divided through their entire length into two portions, ventral and dorsal, by a slight furrow visible on their mesial surface in cross-section. The more ventral portion on each side is the fundamental plate (*Grundplatte*), and the dorsal, the wing plate (*Flügelplatte*). It is necessary to introduce these terms, since the fate of the wing plate and fundamental plate are points of special interest. Without the figures, a description of the changes which this typical form undergoes in the different vesicles would be of no value. This type can be followed even into the forebrain, where the ventral plate becomes the infundibulum, the fundamental plates the corpora striata, and the wing plates take part in the formation of the hemispheres, while the dorsal plate helps to form the inner wall of the anterior portion of the hemispheres.

The histological changes follow the same order in the brain region

that they do in the spinal cord. It is the region of the medulla, and specially the caudal portion of it, that leads in the development, a fact that can be brought into connection with the highly complicated character of this region and its fundamental importance to the organism. The relation of the cranial nerves is very interesting. The motor nerves of the spinal cord are found to arise from the cells in the fundamental plate. All the motor cranial nerves also arise from cells in the fundamental plate. In the lower cervical region, however, this solid nucleus of cells, which has thus far run the entire length of the cord, separates into two portions, a dorsal and ventral, the former giving rise to the accessory fibers which emerge along the line of juncture between the fundamental and wing plate. This double origin is carried up into the cranial nerves, and one set are found arising plainly from what is a continuation of the ventricular nucleus, while the other is equally plainly a continuation of the accessory. To the former belong the hypoglossal, abducens, trochlearis and oculo-motor, while to the latter, the dorsal, belong the motor portion of the vagus, glossopharyngeus, facialis, and the motor portion of the trigeminus, at least in part. The sensory roots also are similar to the spinal in their mode of origin. For the spinal cord the sensory roots arise from bipolar ganglion cells which form the spinal ganglia that lie outside of the nerve tube. As His points out, there is some reason to think that in the adult certain fibers in the posterior roots are unconnected with these ganglion cells, but he adds that he has no evidence at all on the point from his embryos, and is thus compelled to ignore the question for the present. The sensory cranial nerves arise also from outlying ganglia. These are four in number—the trigeminal, the acustico-facial, the glossopharyngeal, and the vagus masses. In development all these masses undergo differentiation which cannot here be followed, but they all agree in sending bundles of fibers towards the nerve tube, which then apply themselves to the wing plate, and turning, run longitudinally. There is this difference between the bundles thus formed, that those arising from the spinal nerves turn so as to run cephalad, while those formed by the cranial nerves run caudad and form the "ascending" roots of the anatomists, for their respective nerves. It will be further seen that there are no sensory nuclei in the nerve tube which are at all homologous with the motor nuclei, the connection of the sensory fibers being far less localized. It is also interesting to consider that since the bundles of sensory fibers from the spinal nerves form the rudiments of the posterior columns, so the roots of the sensory cranial nerves, being homologous with them, form what may be considered as the prolongation of these posterior columns. From all of which it follows that cranial and spinal nerves are fundamentally similar in their origin and development.

In next describing the manner in which the peripheral nerves grow out, His finds many illustrations of purely mechanical influences controlling their course, division, etc. Those who are at all familiar with the labors of this author will recognize that he has here a peculiarly favorable field in which to develop his view of the very great importance of mechanical causes in controlling the form of our body and its organs. In discussing this point he specially emphasizes the importance of the sequence of events. For example, an outgrowing nerve stem splits on pressing against a cartilage that

lies in its path. Suppose the cartilage had not developed until after the nerve had grown quite past this point; it would then be easily conceivable that the form of the nerve stem might have been quite different. The sequence of events becomes, then, a matter of prime importance, and he summarizes it for this period as follows: 1. Formation of the myelospongium (the non-nervous framework); 2. development of axis cylinders from the nerve cells; 3. formation of first nerve trunks leaving the center; 4. development of the outlines of the skeleton; 5. gradual growth of the nerve trunks towards the periphery; 6. development of the protoplasmic processes from the cells in the central system.

For brain anatomy the paper is specially important; for many current views regarding the nature and significance of the cranial nerves will find in it their best evidence, as well as their most serious difficulties.

Ueber die Bestandtheile des vorderen Kleinhirnschenkels. W. Becterew. His and Braune's Archiv, 1888, No. 2 bis 4, S. 124.

On the basis of embryological studies Becterew describes, in the superior peduncle of the cerebellum, four bundles of fibers which acquire their medullary sheaths at different periods. A transverse section between the corpora quadrigemina and the cerebellum in the adult shows dorso-laterally on either side of the middle line the conspicuous crescent formed by the fibers of the superior peduncle. Referring to such a section, the author describes these four bundles as occupying the following positions: (1.) The first is earliest developed, and is found in the sharp ventral angle of the crescent. It does not arise from the cerebellum, but is lost in the principal nucleus of the vestibular nerve. Small in extent, it passes as far as the cephalic edge of the pons where the fibers cross the middle line as a commissure. This is the ventral bundle. (2.) The second in order is the dorsal bundle which forms the dorsal portion of the crescent, and arises from the nucleus fastigii and the cortex of the vermis on the corresponding side. (3.) Between these two, on the lateral curve of the crescent, appears the so-called middle bundle, the fibers of which mix partially with those of the bundles just described. In the cerebellum these fibers are in connection with the nuclei globosus and emboliformis. (4.) The last to develop is the one filling the remaining space along the mesial curve of the crescent, the inner bundle. It arises in part from the corpus dentatum and the cortex of the cerebellar hemispheres. The three bundles last named form the superior peduncle proper, and crossing the middle line end in the cells of the red nucleus. Becterew regards these three as a physiological continuation of the bundles which form the inferior peduncle of the cerebellum.

The Development of the Peripheral Nervous System of Vertebrates (Part I, Elasmobranchii and Aves). J. Beard. Quart. Journ. Micr. Sci., Vol. XXIX, 1888, pp. 153–227, plates 16-21.

This elaborate paper is a continuation of the author's morphological studies upon the development of the peripheral nervous system of vertebrates, and is very largely discussional. According to Beard, the spinal ganglia of vertebrates are formed as differentiations of the inner layers of the epiblast just without the limits

of the neural plate. The "Zwischenstrang" of His has no share in the formation of the ganglia, and the "Zwischenrinne" of the same anatomist has no existence. After separation from the epiblast, the neural cranial ganglia and the spinal ganglia are carried up with the closing in of the neural tube, and come to lie between its lips, but are quite distinct from the central nervous system. The neural cranial ganglia grow towards the lateral epiblast at the level of the notochord and fuse with it. In addition to the four elements of the anterior and posterior roots, two ganglionated and sensory, two motor and unganglionated, the cranial nerves contain a fifth element, derived from the lateral or branchial sense organs. Beard confirms the opinion of Balfour respecting the origin of the anterior roots of cranial and spinal nerves. F. T.

Sur la persistance de l'aptitude régénératrice des nerfs. C. VOULAIR. Bull. de l'Acad. d. Sc. de Belge [3], XVI, 7, p. 93.

The author cut the sciatic nerve in dogs and obtained the usual regeneration. Hoping to get this a second time in the same dog, he again cut the nerve, but without the desired result. The failure of the tissue to renew itself a second time in this case he attributes to the disturbance of the circulation, etc., following the operation, and to the resistance which the peripheral connective tissue offers to the proliferation. On the other hand, he did obtain regeneration for the second time in the poplitaeus internus of the dog, and concludes, from two successful experiments, that the same nerve may regenerate itself at least twice, perhaps more often.

Ueber die centrale Endigung des Nervus opticus bei den Vertebraten. J. BELLONCI. Mit 8 Taf. u. 4 Holzsch. Zeitschr. f. Wissen. Zool., B. 47, H. 1, 1888.

During the past ten years Belloncí has published a number of papers on the finer anatomy of the central nervous system, and his work has been for the most part comparative. All this gives him facility in handling a complicated problem like the one indicated in his title. He has worked over the optic centers and nerves in the reptiles and batrachia, the teleost fish, the birds, and the mammals, thus obtaining four types for comparison. The method which was most successful was a staining and hardening in osmic acid, followed by clearing the section with ammonia. The effect of this treatment was to leave visible only the fibers stained with osmic, the remainder of the section becoming completely transparent. Most of the numerous figures accompanying the paper are made from such specimens, and certainly show the fibers with great clearness. The disadvantage of the method is that only small pieces of tissue can be used, and therefore the brains employed must always be of small size. The plan of the investigation is an analysis of the fiber systems found in the optic tract and the adjoining regions, and a following of each of these to its termination. In pursuing such a plan much detailed description is required, which it is of course impossible to summarize. The optic fibers proper are traced to their destination by the study of serial sections in several planes. This method leads to the general conclusion that all optic fibers end in the corpora optica, the homologues in the vertebrate series of the corpora quadrigemina anteriora in man. The fibers coursing

through the geniculate bodies and thalamus, according to Bellonci, give off at most fine branches to the cells of these parts, but do not lose their identity, whereas when the fibers reach the corpus opticum they branch, forming a profuse network, and there really terminate. The criterion of termination is then, for Bellonci, the formation of a fine network and the consequent loss of identity.

At first sight these results appear quite revolutionary, but it is not impossible to harmonize them with the current views based on other methods. The author, however, recognizes that his work bears on the problem from but a single stand-point, and that the true conclusion can be reached only after the matter has been tested from every side. The structure of the corpus opticum is fundamentally similar in all the types.

A nucleus of varying value and position, sometimes covered by the corpus opticum and sometimes exposed, forms his corpus posterius, which he clearly shows to be the homologue of the corpus quadrigeminum posterius in man. The commissura posterior of v. Gudden appears to end here after passing through the internal geniculate body, into connection with which some authors have previously brought it. The optic region in the birds was found to conform with the type shown in the teleosts rather than with that found in the reptiles and batrachia. In no case is any mention made of an uncrossed bundle of fibers in the optic tract such as exists in the higher mammals. This negative point is of interest, since the method used was well fitted to demonstrate the bundle if it was present in the small mammals—mouse, rat, guinea-pig, etc., which were studied. The manuscript and plates were completed in 1885, but for some unexplained reason have been delayed in publication.

Beiträge zur Kenntniss der Sehnervenkreuzung. J. SINGER und E. MÜNZER. Denkschr. d. Mathematisch-Naturwissensch. Classe d. Kais. Akad. d. Wissensch. zu Wien, Bd. LV, S. 163, 1888. Abstract by Steinach, Centralbl. f. Physiologie, No. 25, März, 1889.

Michel's paper (Festschrift zum 70 Geburtstage Kölliker's, Würzburg, 1887) has recently reopened the discussion on the partial decussation of the optic fibers. The authors have again taken up the problem, and by the aid of a new method, first described by Marchi and Algeri, have obtained some important results. The point of the method consists in treating small pieces of the tissue, in the early stages of Wallerian degeneration, first with Müller's fluid and then with a mixture of Müller's and osmic, with the result of tinging the normal nerve fibers light brown, whereas those undergoing degeneration appear intensely black. The course of the optic fibers was studied in the pigeon, owl, guinea-pig, white mouse, rabbit, dog and cat, the procedure being to enucleate one eye, kill the animal at the end of two or three weeks, and then study sections of the optic fibers through their entire course. It appears that the decussation is a total one in the pigeon, owl, white mouse and guinea-pig (a result quite in agreement with that of Bellonci noted above), while in the rabbit, dog and cat it is partial, the uncrossed bundle increasing in size in these animals in the order in which they are named. They further show that the uncrossed fibers do not normally form a bundle, but are scattered among the others. When,

however, the nerve of one eye is caused to atrophy, the corresponding optic tract still contains the uncrossed fibers for the remaining eye. Owing now to the atrophy of the bulk of the fibers in this tract, the fibers remaining aggregate, and thus do form a bundle in such a specimen. It was this appearance which led v. Gudden and Ganser to describe these fibers as forming a bundle in the normal animal.

Ueber die Chiasma Nervorum opticorum des Menschen. ST. BERNHEIMER. Bericht über den VII intern. Opthalm. Congr. zu Heidelberg, 1888, S. 317. Abstract by Steinach, Centralbl. f. Physiologie, No. 25, März, 1889.

The same problem is attacked by Bernheimer by quite another method. He has studied the development of the medullary sheath of the optic fibers in foetuses and young infants. Before the 30th week of embryonic life, the medullary sheaths are undeveloped, and the chiasma at this period is formed by a network of axis cylinders imbedded in vascular connective tissue. Not until the 30th week do branched particles, staining by Weigert's method, appear. In older embryos these gradually become larger and more branched and finally fuse, thus marking out very fine medullated fibers. These latter increase both in size and number during the remainder of intra-uterine life, but it is not until the second or third week of extra-uterine life that a section is made up of fibers all of which are medullated; these in turn increase in diameter up to the end of the first year of infancy. In this last stage the fibers are too numerous and interwoven to permit the observation of the course of single fibers. If, however, complete series of thin sections are examined from specimens between the 30th week of intra-uterine and the 3d week of extra-uterine life, there are always to be found fibers which enter the right optic tract from the right nerve and the left from the left, *i. e.* do not decussate. They run mainly in the dorsal half of the chiasma.

Aneurism of an Anomalous Artery causing Antero-Posterior Division of the Chiasm of the Optic Nerves, and producing Bitemporal Hemianopsia. S. WEIR MITCHELL. Journ. of Nervous and Mental Diseases, Jan., 1889.

In 1886 a man of 43 years presented himself as a patient, exhibiting as chief symptoms fatigue after unusual exertion, a tendency to numbness in the limbs, and, for a year previous, varying and gradually increasing pain in the parietal and vertex regions. An examination of the eyes showed complete anaesthesia of the nasal half of each retina. The color sense was unimpaired. The diagnosis was pressure in front of the chiasma, sufficient to cut off the connection between the inner halves of each retina, with partial atrophy, especially in the left nerve, inferred from the diminished acuteness of vision. The headaches continued, and later there was at times a passing sense of mental confusion. In May, 1887, he died suddenly, having been for some hours comatose.

At the autopsy the optic nerves were found separated fully an inch by a large tumor that lay directly between them. The tumor had apparently destroyed the chiasma and pressed deeply into the brain substance in the middle line, though not adherent to it. The two internal carotids were found intimately connected with and appa-

rently forming the tumor. To explain this it is assumed that an anomalous artery connected the carotids at the point just below the chiasma, and this becoming aneurismal, caused the destruction of the chiasma, and forced its way into the brain substance above. The case is unique, and shows the partial crossing of the optic fibers in man, as well as the portions of the retina with which the two groups of fibers are respectively connected. Neither the optic nerves nor the brain were in a condition to permit of a microscopical examination. The paper closes with a discussion of the anomalous connecting branches observed in the circle of Willis, with a view to fully justifying the statement that the tumor was due to an aneurism in an anomalous artery.

Zur Physiologie des Vogelgehirns. M. E. G. SCHRADER. Pflüger's Archiv, XLIV, S. 175. Reviewed by Paneth in Centralbl. f. Physiol., März, 1889, No. 25.

This interesting paper opens with a discussion of previous investigations of the bird's brain, and has to urge against much that has been done, both the failure of the experimenters to treat the problems in a thoroughly objective way, and to control their results by suitable autopsies. It has been possible to remove the forebrain completely without injury to the remaining portions. The mortality immediately after operation is high, and of those that live for weeks after it, a portion show progressive emaciation and stupor, terminating in death. In the first days after operation the animals exhibit as a rule stupor and lack of voluntary motion, as described by Flourens. After this they move about the room, avoiding obstacles, even such as a dusty plate of glass, and can climb out of a cage with high sides. In the early stages they can easily be put to sleep by holding them or putting them on a perch, which shows that the movements are not forced. At night they roosted naturally. When placed on a rotating object they balanced very well for a time, and then flew off, evidently choosing the object towards which they flew. Alighting was accomplished with ease, but they could not rise from a flat surface like the floor. In some cases the period of stupor did not occur, and the animal moved about almost immediately after the operation in a way which showed that it could see fairly well from the very first. The reaction to sound was obtained with a percussion cap, by the explosion of which they were startled. The tests of other senses were not satisfactory, for Schrader did not get any good reactions on normal birds with which they could be compared. Birds without the forebrain did not eat voluntarily, but, as is well known, could swallow food fed to them. The operated birds slept, and became restless when left for too long a time without food. They showed heat, though they did not recognize the female, and a mother could not feed her young. The whole activity of such birds is reduced to the simplest terms.

Other birds were rendered blind. When the behavior of these was studied, it was found that they were in certain ways more defective than those without the forebrain. They could feed, but did so only at long intervals. They could not orient themselves, and remained for days resting on a perch, though it was close to the floor. The loss of sight evidently deprived them, as might be expected, of the majority of their most important sensations. So far as observed, no compensation through other senses took place.

Experimentelle Untersuchungen über die Beziehung der motorischen Ganglienzellen der Medulla spinalis zu peripheren Nerven. A. v. Sass. Inaug. Dis., Dorpat, 1888. Reviewed by Openchowski in Centralbl. f. Physiol. No. 25, 1889.

By a systematic application of v. Gudden's method, by which the atrophy of the central end of a motor nerve and its corresponding nucleus is brought about when the peripheral portion has been removed in a very young animal, Sass sought to determine the position and extent of some of the motor-nuclei in the spinal cord. The animals having been allowed to live some time after operation, serial sections of the cord were made and the number of ganglion cells in the corresponding halves compared, it having been previously determined that in a normal animal they were approximately equal in number on the two sides. By the decrease in the number of ganglion cells in one half of the cord, the extent and outlines of the nuclei could be traced.

The author concludes that the nuclei of the spinal nerves are not distinctly circumscribed, but that the nuclei run into one another. The motor region for the median nerve is in the caudal two-thirds of the eighth cervical segment, the cephalic third of the seventh and caudal third of the sixth; that for the radial nerve in the cephalic third of the eighth, in the seventh and in the cephalic half of the fifth cervical segment; that for the ulnar in the cephalic half of the first dorsal, and in the cephalic third of the eighth cervical. The nucleus of the ischiadic nerve was found, in conformity with the results of v. Gudden and Mayser, in the caudal portion of the lumbar enlargement.

Anatomische aanteekeningen naar aanleiding van een geval van atrophie van het linker corpus mamillare. C. Winkler und J. Timmer. Feestbundel van Donders, p. 26. Reviewed by Heymans, Centralbl. f. Physiol. No. 25, 1889.

From the study of rabbits and dogs v. Gudden reached the conclusion that each corpus mamillare contained at least two nests of cells—a medial and lateral. The medial nest connected mainly with the ascending pillars of the fornix, while the lateral one was connected with the bundle of Vicq d'Azyr, which in turn is connected with the tuberculum anterius of the optic thalamus. v. Gudden further described a crossed bundle, which now bears his name, the bundle of v. Gudden, and which passes from the corpus mamillare caudad and disappears among the tegmental fibers. The applicability of these results to man has been questioned by Flechsig, though v. Monakow has already described three pathological human brains which in general support v. Gudden's results. The fourth case is now described by the authors. It was the brain of an idiotic and epileptic girl, showing marked degeneration in the left hemisphere, and that specially in the parietal and occipital lobes. The basis of the brain was symmetrical save that the left corpus mamillare was atrophied to almost half the normal size. The corpus striatum was alike on both sides, but the tuberculum anterius was atrophied completely, while the pulvinar was somewhat smaller on the left side. Microscopical examination revealed a slight atrophy of the cortex of the gyrus hyppocampus, with complete atrophy of the cortex of the parietal and occipital lobes, an interesting partial atrophy of the left ascending pillar of the fornix, the lateral gan-

glion of the corpus mamillare and the bundle of Vicq d'Azyr, but there was no indication that this bundle crossed as described by v. Monakow. These facts, besides showing the multiple origin of the fornix (v. Gudden), are taken to indicate that the most inferior of the fornix bundles arises from the lateral ganglion of the corpus mamillare (against v. Gudden), and that a connection exists between the tuberculum anterius and the parietal and occipital lobes.

Ueber die experimentelle Verstopfung der Sinus Durae Matris. P. Ferrari. Wiener med. Jahrb. 1888, p. 81.

Contributions showing the conditions necessary for the circulation within the cranium are a natural result of the present interest in the surgical interference with the brain. By the injection of sterilized masses of wax and oil into the various cranial sinuses of the dog, the author has produced a mechanical obstruction in different portions of the venous outflow from the brain. The injection was made through the vena facialis or the vena ophthalmica, as the occasion demanded. By this means the sinuses of the roof or the base of the skull or the sinus cavernosus could each of them be separately injected, and when the injections were made at intervals, wax of different colors was used, thus enabling the experimenter to trace the result of each injection at the post-mortem. The general result was that very extensive plugging of the sinuses could be made without any serious symptoms or without giving rise to degenerative changes in the brain substance in the neighborhood of the plug. Indeed, all the sinuses of the roof could thus be plugged without causing any symptoms, but when all outflow was cut off the dog died in a few minutes, death being usually preceded by an epileptic attack.

Ueber drei Fälle von progressiver Paralyse mit Herderkrankungen in der inneren Kapsel. Th. Zacher. Archiv f. Psychiatrie, XIX, 3, S. 726.

The descriptive anatomy of the brain suffers much confusion from the fact that it is, as a rule, very difficult to designate the exact level of the section by anything except a figure or an elaborate description. The latter is wearisome, but the lack of it may often cause misunderstanding. The position of the various tracts in the internal capsule is a case in point, for here the relative position is largely influenced by the level at which the section is made. This appears to be one source of the somewhat conflicting accounts of several authorities. From a study of his three cases, the author takes sides in the following way. A horizontal section of the brain made at such a level as to give nearly the maximum distance between the head and tail of the caudate nucleus displays the bands of white matter forming the internal capsule, the anterior limb lying between the head of the caudate and the lenticular nucleus, and the posterior limb between the lenticular nucleus and the optic thalamus. The two limbs meet at almost a right angle in this section, and form the portion known as the knee of the internal capsule. In the first case of the author, the lesion involved the major portion of the anterior limb, except the neighboring part of the knee, and no secondary degeneration was found in the corresponding crus. In the second case, the portion of the knee intact in the first instance was affected, and there was marked degeneration in the mesial portion of the pes. From this it is concluded that those fibers coming

from the frontal regions and traversing the entire extent of the internal capsule lie in the anterior third of the knee. In the second case also, the degeneration involved the first third of the posterior limb and there was no degeneration in the pyramidal tract, while in the third case the lesion was in the middle of the posterior limb and the pyramidal tract had degenerated. The last two cases favor Flechsig's view that the pyramidal fibers are never located in the anterior third of the posterior limb of the internal capsule, as against Charcot, who teaches that they extend into this region. In the third case, the lesion, which was on the left side and it will be recollected was accompanied by pyramidal degeneration, had but a *transient* paralysis on the right side as its consequence. This very remarkable fact the author seeks to explain by reference to the results of Goltz on dogs, and in his explanation speaks of fibers for both halves of the body arising from each hemisphere, but both acting only under exceptional conditions.

(Recent work gives ground for expressing this idea in a somewhat different way. The spinal centers in the dog and other lower forms retain the power to act bilaterally, whether the impulse comes from one hemisphere or the other. In man and the apes, this bilateral character is as a rule lost, each half of the spinal center responding to its own hemisphere alone. A case like this would then be an example of the retention of a primitive condition by one of the higher forms.—D.)

Contributo alla fisio-patologia del cerveletto. A. Borgherini. (Revista sperimentale di Freniatria e di Medicina legale, XIV, 81.) Abstracted by Paneth, Centralbl. f. Physiologie, Feb. 1889, No. 22.

The author has spooned out the cerebellum, either in part or completely, from dogs, and afterwards observed them, sometimes for months. In both total and partial removal the symptoms were similar, but more severe and persistent in the former case, as might be expected. Following total removal there was at first great difficulty, which might amount to inability to move, that depended on a spastic condition of the muscles. With recovery from this extreme condition, the motions of the animal still remained slow, uncertain and simple. Sensibility was as a rule unaffected. In cases of partial removal, uncertainty and trembling were the prominent symptoms, which often completely disappeared in a week or two. The muscles of the eyes and of mastication did not appear ever to be affected. To meet the objection that the persistent ataxia in the two cases of total removal was dependent on the secondary degenerations that were found, the author reports the case of a dog becoming spontaneously ill, exhibiting symptoms similar to those in the above two cases, and showing at the autopsy a degeneration of only the gray matter of the cerebellum.

Ein Fall von hochgradiger Zerstörung des Kleinhirnwurms, nebst casuistischen Beiträgen zur Lehre von der sogenannten cerebellaren Ataxie. E. Becker. Virchow's Archiv, CXIV, H. 1, S. 173.

In this case there was during life no disturbance either of motion, sensation or intelligence. The autopsy revealed two old apoplectic cysts, one in the left cerebellar hemisphere, and the other involving all the vermis except the lingula, lobus centralis, uvula and nodulus.

Nothnagel has indicated cerebellar ataxia as an almost unfailing symptom of extensive disease of the vermis, but Becker succeeded in finding in the literature some seven cases similar to his own. He concludes, therefore, that cerebellar ataxia is associated with the lesion of some special tract in this region, and points out that Edinger has described the cerebellar-olivary tract, from the superior olive, crossed corpus restiforme, capsular fibers (Vliess), superior peduncle, to the red nucleus, as probably specially connected with the equilibrium function. This tract Becker specially studied in his case and found it free from secondary degeneration, and therefore concludes that the case favors Edinger's hypothesis.

Ueber den Klangstab, nebst Bemerkungen über den Acusticusursprung. Jul. Nussbaum. Medicin. Jahrbücher, 1888, S. 187.

On examining the striae medullares, which are considered to form a central tract for the accessory auditory nucleus, it is found that only the most cephalically placed bundles decussate immediately beneath the floor of the ventricle. The same is true for the major portion of fibers which appears to have the same origin, but which, after crossing, takes a direction more cephalic along the floor of the ventricle and disappears at its antero-lateral edge, often in the region of the locus coeruleus. This bundle is frequently present, though inconstant and variable, and forms the conductor sonorus (*Klangstab*) of Bergmann. In the conductor there is a central core of cells completely surrounded by fibers. For this structure no function has as yet been assigned. Nussbaum further describes a bundle which follows the striae medullares in its later course, but within the medulla is at first associated with the ascending root of the acusticus.

(When a structure like the "conductor" is described as inconstant, the term must be taken as a rule to apply only to its macroscopic appearance, for the same structure sunk somewhat below the floor of the ventricle would not be discoverable on superficial examination.—D.)

Herderkrankung des unteren Scheitelläppchens. C. Wernicke. Archiv f. Psychiatrie, XX, 1, S. 243.

A man of 70 years suffered a slight cerebral attack without external injury. The head tended to the right, and there was slight sensory and motor paralysis in the left side of the body, the facialis included. The most striking symptom was, however, the conjugate deviation of the eyes to the right, with inability to turn them to the left. This disappeared in a few days. A second attack was followed by almost complete paralysis of the left arm and leg—transient but considerable disturbance of speech, the paralysis of the left facialis remaining insignificant; three days later divergent strabismus of the right eye. A few days after the second attack the patient died. Wernicke had diagnosed a lesion in the inferior portion of the parietal lobe, and a second in the region of the internal capsule. This second lesion was necessary to explain the complete hemiplegia consequent on the second attack. His localization of the first lesion was based on a case of Grasset's (Montpellier Med., June, 1879), and the experiments of Ferrier and Munk, in which conjugate deviation of the eyes was found associated with the angular gyrus. A softening in this locality would also account for the other sensory

disturbances following the first attack, since just beneath this region the sensory fibers for the entire body are most compactly grouped. The autopsy fully confirmed the diagnosis. There were several small cortical lesions and an old lesion in the pons—all without significance for the present discussion. Besides these, however, there was a fresh lesion in the third member of the right lenticular nucleus, which would easily involve the pyramidal tract, while the white matter of the lower portion of the right parietal lobe was completely softened, thus fully accounting for the other symptoms. A review of the literature brought to light a considerable amount of evidence showing conjugate deviation of the eyes in similar lesions of the parietal lobe.

Die Beziehungen der hinteren Rindengebiete zum epileptischen Anfall. H. UNVERRICHT. Deutsch. Archiv f. klin. Med. XLIV, 1, S. 1. Reviewed by Ziehen, Centralbl. f. Physiol. No. 25, 1889.

The starting point for an epileptic attack is usually thought of as in the motor region of the cortex, but Unverricht considers it as clinically established that a strictly local affection of the posterior cortical regions can of itself bring about convulsions. He seeks to demonstrate the point on dogs, in which the stimulation, especially of the posterior and superior portions of the second arched convolution (counting from the middle line) causes contractions. There is lateral motion of the eyes to the opposite side, with dilation of the pupils as one of the results. These are not explained as reflexes from sensory stimuli (Ferrier), but as the result of direct stimulation of motor centers. But this is simply the author's view, for which the evidence is lacking thus far.

The length of time the stimulus is continued is more important than the strength of the stimulus, in determining an attack from this posterior cortical area. The order of contractions often fails to follow the order of the centers, and at times the convulsions roused from one visual area are limited to one half of the body. Most important are two experiments in which on the left side all the motor region save that for the movements of the eyes had been removed. The visual area was then stimulated on the left side, and the convulsion appeared on the *same* side. When a transverse cut was made through the cortex of one hemisphere at the anterior edge of the visual area, then stimulation of the latter caused a convulsion in which the orbicularis contracted after the extremities, from which he concludes that the impulse travels through deep-lying connections. At the end some clinical evidence is presented.

Kleine Beiträge, betreffend die Anordnung der Geschmacksknospen bei den Säugethieren. J. HÖNIGSCHMIED. Zeitschr. f. wiss. Zool., Vol. XLVII, 1888, S. 190–200.

This paper contains the results of the author's further studies upon the arrangement of the gustatory papillae and distribution of the taste-bulbs in mammals. In *Felis lynx* there are present six papillae of the circumvallate type, but the foliate papillae are wanting. The taste-bulbs are rather narrow and disposed in a zone of 3 to 5 tiers. *Ursus fuscus* has about twenty circumvallate papillae, and also well-developed foliate organs. The taste-bulbs are oval or cylindrical in form and, in the circumvallate papillae, are arranged

in a zone of 21 to 25 tiers. In vertical section the folds of the foliate organs show 5 to 20 rows of bulbs. *Equus asinus*, like the horse and mule, has two circumvallate papillae and foliate organs. The taste-bulbs are long and narrow, and those of the circumvallate papillae are arranged in a girdle of 5 to 10 tiers. The folds of the foliate areas contain 5 to 10 rows of bulbs. In *Cricetus frumentarius* the foliate type of taste organ is present, but circumvallate areas are lacking, although Mayer mentions finding a single circumvallate papilla in the hameter. The folds of the papillae foliatae bear from 2 to 10 rows of nearly spherical bulbs. *Sus scrofa*, like the domesticated pigs, possesses two circumvallate papillae and foliate structures. In the former region the bulbs are long and narrow, and the tiers vary in number from 7 to 25. The folds of the foliate papilla show 5 to 16 rows of bulbs. In *Mus sylvaticus* there is but one circumvallate papilla, while *Myoxus avellanarius* possesses three papillae of this type. In neither of these species, apparently, was a thorough search made for foliate taste areas. In none of the animals investigated were taste-bulbs detected in the epithelium of the upper surface of the circumvallate or foliate papillae, nor were any found in that lining the outer wall of the trenches encircling the former. Hönigschmied found fungiform papillae bearing taste-bulbs in *E. asinus*, *S. scrofa*, *C. frumentarius* and *M. avellanarius*. Both Hönigschmied and Brücher regard the circumvallate papillae as modifications of the fungiform type. While this hypothesis may be true in the case of certain individual papillae, it seems highly probable that the circumvallate papilla, as a distinct taste area, has been developed through a long series from the gustatory or bulb-bearing ridges. These ridges, which have been found in *Ornithorhynchus anatinus* and *Belideus ariel*, are probably the nearest approach among living animals to the primitive type of gustatory area of Mammalia, and are doubtless the forerunners of the circumvallate type of papilla. F. T.

II.—EXPERIMENTAL.

Ueber die Helligkeitsempfindung im indirecten Sehen. A. Kirschmann. Philosophische Studien, V, 3, pp. 447–497.

Kirschmann, without having seen the work of A. E. Fick, examined the lateral portion of the retina in regard to its sensitiveness to brightness. His results are of a different nature from Fick's, for his eyes were examined under ordinary conditions, and Fick's only after prolonged adaptation. He finds an increase of sensitiveness amounting to a fraction of the whole—one-seventh for 20° away from the center—while Fick found a sensitiveness fifteen times as great as at the center. The latter result is plainly very different from anything which takes place under ordinary conditions, or we should not fail to be easily aware of it.

The different parts of the retina differ in respect to (1) the distinctness, (2) the quality, and (3) the intensity of the sensations which they convey. (1) On account of the unfavorable conditions for refraction and accommodation, the images on the side parts of the retina are not good; but this alone is not enough to account for the degree of indistinctness of vision that prevails there—the eyes of

rabbits, for instance, are such that very sharp images are formed in the periphery. It is necessary to assume therefore that the diminished number of nerve-ends is an additional cause. (2) There is an important modification of the color-sense towards the periphery; at a certain distance blue and yellow only are seen, and farther away no color at all is distinguished. But the changes which colors undergo as they are looked at peripherally are very different from those which are caused by a diminished brightness; red becomes orange when it is looked at with the periphery, but when looked at in a faint light, black; neutral violet becomes blue and gray respectively. Hence a diminished brightness cannot be the cause of the change. (3) That a diminished brightness does not occur on the border is made plain by these experiments. Two black and white rotating disks were looked at, one with the fovea and one with some other portion of the retina, and black was added to the latter until it looked no brighter than the former. A maximum sensibility was found at a distance of 20°—25° in a horizontal direction, and 12°—15° in a vertical direction. The increase of sensibility is much greater horizontally than vertically. An interesting fact is that the lower portion of the retina is less sensitive to brightness than the upper portion. We have no occasion to notice slight changes of brightness in the sky, but it is essential to safe moving about that unusual things on the ground should attract our attention.

Kirschmann draws attention to the fact that the cone of light which can enter the pupil from an object far to one side is very thin, and hence that the objective brightness of things seen laterally is diminished in the ratio of the cosine of the angle, if the object is far away. Hence the actual increase in sensibility in the lateral portion of the retina must be greater than the apparent increase by an amount enough to make up for this objective decrease of brightness. After taking account of this, the curve of increase is found to be a straight line. The cause of this greater feeling for brightness in the non-foveal portion of the retina he finds in the supposition that the end-members of the rods, which are much more developed than those of the cones, act as reflecting mirrors to send some light back upon the nerve-terminations. It remains to be found out whether the rods are most numerous at the place where he finds the maximum sensibility.

An interesting fact which appears from his tables, but which Kirschmann himself does not mention, is that for bright objects (the background was constant, 270 black + 90 white) the nasal portion of the retina is decidedly better than the temporal. This is a difference which, as Schön has shown, is of great importance in enabling us to determine whether a given pair of double images belong to an object without or within the horopter—so great that by an artificial alteration in the relative brightness of the images an error of judgment in this respect may be produced. C. L. F.

Ueber den Lichtsinn der Netzhautperipherie. TREITEL. Arch. f. Ophth. XXXV, 1, p. 50.

This is the third independent investigation into the sensibility of the lateral portions of the retina that has been made within a very short time, and the difficulty of the subject is apparent from the fact that all three investigators, A. E. Fick, Kirschmann and Treitel, have obtained very different results. Treitel finds the lateral portion less

DO NOT

sensitive than the fovea, Kirschmann finds it more sensitive by about one seventh, and Fick finds it ten to fifteen times more sensitive. The experiments of Fick seem to us to have been conducted with much the most acumen and with the most careful avoidance of sources of error. In the first place, his object was seen by transmitted light, instead of by reflected light. A small piece of porcelain was lighted up from behind, and the amount of light allowed to fall upon it was regulated by a diaphragm. Both the other observers used Masson disks, and measured the amount of white necessary to add to the black to make the disk just perceptible; their source of light was the windows of the room, or the windows somewhat darkened by curtains. But every one knows that it is almost impossible to hold two strips of paper, near together even, in front of several windows, in such a way that they are equally lighted. Kirschmann, it is true, had windows looking upon a gray wall, and allowed for the contrast effect of his background, but neither of these precautions was taken by Treitel. The results of Fick and Kirschmann are not really incongruous, for Kirschmann worked by day-light and Fick in the dark; and even Treitel found that the supposed superiority of the fovea was almost evanescent in a diminished light.

In the second place, it was discovered by Schadow that the presence of a bright image on the fovea renders the lateral parts of the retina much less sensitive than they would be without it. Treitel maintains that it is impossible to steadily fixate a point when there is nothing to look at; that may be so in general, but if there is a bright point above and one below, it is not difficult to keep the eye steady half way between them, and this is the device which Fick made use of. Treitel finds the retina one tenth as sensitive at a distance of thirty to forty degrees from the center in daylight, but half as sensitive in a faint light. The difference he attributes to the more ready fatigue, and hence the slower adaptation of the center. But it has never been shown that the center is more easily fatigued than the periphery. This is really a case of question-begging. It can only be more readily fatigued by being more sensitive, and whether it is more sensitive or not is the very question at issue. A supposed fact is not rendered more probable because it can be explained by something else which is a mere re-statement of the fact itself. Moreover, a common experience shows that the center is less subject to fatigue than the periphery; any one whose eyes have been pained during sickness by the presence of a light in the room knows that it can be much more easily endured by looking directly at it.

On the whole, the subject seems to be left at present in a good deal of confusion. The former observers who agree with Treitel are Rupp, Exner, Dobrowolsky and Gaine, Chodin, and Bull; those who disagree with him are Aubert (but he thinks the adapted eye is about the same throughout), Schadow, Charpentier, and Butz. But the experiments of Fick, as we have already said, seem to us to carry more conviction with them than any of the others.

C. L. F.

Ueber intermittirende Netzhautreizung. BELLARMINOW. Arch. f. Ophth. XXXV, 1, p. 25.

Kirschmann has just called attention to the fact that two sensations furnished by a rotating disk are fused into one sensation with less velocity of rotation at the fovea than in the periphery. Bellar-

minow has made an extended series of experiments on this subject. Exner had already noticed (*Pflüger's Archiv*, Vol. XXXII) that the periphery is more sensitive to change of brightness than the center, and that it has a special tendency to interpret change of brightness as due to motion. Hence it detects small motions more readily. Bellarminow regulated the intensity of the light by the width of a slit, produced intermittance by a rotating disk, determined the velocity of its rotation by the pitch of its musical note, and used the spectrum for experiments in color. In a faint light the rapidity of rotation necessary to cause flickering to cease was only two-thirds as great at the center as in the periphery. In strong light the difference was not so great. Blue and violet gave the same results as white light, but green, and still more yellow, fused at high intensities soonest in the periphery. The size and shape of the object looked at seemed to have no effect on the result. The author attributes these results to the greater intensity but shorter duration of after-images in the periphery. He does not make it plain how that, if it were true, would be an explanation. Nor does he give anything to show that the greater sensitiveness of the periphery is not a quality of cortical instead of retinal vision. It might well be that we had the habit of giving such instantaneous and undivided attention to indications of motion in the lateral field of vision as would be quite sufficient to account for a greater power of detecting it. There is at present, of course, no sure way of distinguishing between the retinal and the cortical divisions of the visual process.

C. L. F.

Physiologische Studien über die Orientirung, unter Zugrundelegung von Yves Delage Etudes expérimentales sur les Illusions statiques et dynamiques de Direction pour servir à déterminer les Fonctions des Canaux demicirculaires de l'Oreille interne. HERMANN AUBERT. Tübingen, 1888, pp. 122.

The fact that nearly all the other works on the subject of the functions of the semi-circular canals were either written in German or have already been translated into German (the brief papers of Laborde and Crum Brown form the only exception) has induced Aubert to translate this work of Delage's, which appeared originally in the *Archives de Zoologie expérimentale*, 1886 (see review in this JOURNAL, Vol. I, p. 179). He takes occasion to add many foot-notes of his own, chiefly confirmatory of Delage, in view of the fact that his own complete investigations on the subject will not be ready for publication for some years to come.

Since Delage's articles were written, the question whether the semi-circular canals are or are not organs for the perception of rotation has been set at rest by the admirable work of Breuer in producing determinate rotations of the head in doves by electrical stimulation. (See Pflüger's Archiv, Bd. 34, p. 135, reviewed in this JOURNAL, Vol. II, p. 332.) But in what way the sensation is excited still remains an unsettled question. Breuer produces the compensatory motions of the head (and hence, by inference, the sensations) by drawing out the endolymph with a piece of blotting-paper, but this does not prove that an actual motion of the endolymph must take place every time that the sensation is produced. A retarded flow of liquid in large glass tubes made in the shape of the canals takes place in a way that would exactly explain all the phenomena, but most writers

agree (and Mach has shown by experiment) that that retardation would not take place in tubes so small as the actual canals, and hence there is nothing but changes of pressure to fall back upon. Aubert does not obtain the same experimental results as Delage when it is a question of throwing doubt upon the sufficiency of this explanation, and Mach maintains that the change of pressure which would take place is not too inconsiderable to produce the required effect (*Bewegungsempfindungen*, Leipzig, 1875). The work done in hearing the lowest perceptible sounds, according to Töpler and Boltzman, is 1 : 3,000,000,000 of a kilogrammeter per second ; in seeing the faintest lights, it is, according to Thomson, 1 : 5,740,000,000 ; and Mach's calculations show that much more than that would be done in the semi-circular canals. C. L. F.

Zur Physiologie der Bogengänge. J. Rich. Ewald. Pflüger's Archiv, Bd. XLIV, H. 7–8–9.

On opening the bony semi-circular canals of a dove, variations in the level of the perilymph are sometimes to be observed, which have been connected by some observers with the rhythm of the heart. It seemed to Ewald at first that they rather followed respiration, but he later discovered that they were produced by the movements of the lower mandible, which sometimes accompany respiration, and occasionally for a few seconds are as rapid as the pulse. The mandible moves the adjacent parts of the skin, and they the ear-drum, which communicates the motion indirectly to the perilymph. In uninjured canals the changes in the level must be changes of pressure, affecting both perilymph and endolymph, but do not cause sensations of rotation, because the pressure is equal in all the ampullae. The impulses are too few and too gentle to cause sensations of tone or noise, but probably do cause momentary deafness, as yawning does in man.

Bydrage tot de physiologie van den reuk. H. Zwaardemaker. Feestbundel van Donders, 1888, p. 179. Abstract by Heymans, Centralblatt f. Physiol. No. 26, 1889.

Using yellow wax to produce an olfactory stimulus, the author found that 0.1 second elapsed before the odor from a surface of 122 sq. mm. held before the nose was perceived. With smaller surfaces the time was longer (though not shorter with larger ones), and warming the wax quickened its perception. He found also that different odors diffuse themselves in still air at different rates. At a distance of 40 cm. and a temperature of 15° acetic ether was perceived in 4 seconds, sulphuric ether in 9, soap and tallow in 10, paraffine in 18, camphor in 19, yellow wax in 20, turpentine in 22, vulcanized rubber in 45, thus forming a series according to rate of diffusion from the most to the least volatile, the rate depending on the physical peculiarities of the molecules. The author has devised an instrument with which to test the sense of smell, depending on the relation of the area of the exposed surface of the odorous substance to the intensity of the odor. Individuals differ as to acuteness, but for the same person and the same substance the acuteness is constant. The author considers the olfactory stimulus to be a chemico-mechanical one.

The Limits of Hearing. J. KERR LOVE. Jour. of Anat. and Physiol., Vol. XXIII, 1889, pp. 336–339.

Love concludes, from experiments made with large tuning-forks and with a series of vibrating metallic tongues, that notes produced by fifteen or sixteen vibrations per second are the lowest which can be heard by the human ear. He describes minutely an instrument of his own device for determining the smallest appreciable difference in pitch. For untrained and slightly trained ears the least observable difference of pitch is from $\frac{1}{8}$ to $\frac{1}{12}$ semitone. A twenty-fourth semitone is a common limit. The ears of such trained musicians as violinists, tuners, and some pianists, can detect with certainty a difference of $\frac{1}{24}$ to $\frac{1}{60}$ semitone. All observers, but especially the untrained, detect sharpened better than flattened intervals. Generally speaking, Weber's law holds good for all but the highest and lowest parts of the musical scale. Love considers Politzer's acoumeter the best test we have for determining the distance at which a note of given intensity can be heard. With this instrument a sound can be heard by normal ears in almost perfect stillness at a distance of 15 or 16 meters. Tone or note-deafness is discussed, and the conclusion is drawn that such cases of deafness (deafness to intervals of a whole tone or more) are very rare, but that some well authenticated instances have been recorded. F. T.

Ueber das Verhalten von Vocalen und Diphthongen in gesprochenen Worten. Untersuchung mit dem Sprachzeichner. WM. MARTENS. Zeitschrift f. Biologie, Bd. XXV, H. 3.

This research is in a sense supplementary to that of Wendeler on the consonants, executed with the same instrument. (See notice of the instrument, AMER. JOUR. PSY. Vol. I, p. 315.) The author had such phrases as *Vater und Mutter, Der Donner rollt, Mein kleines Kind*, etc., spoken into the instrument, and compared the tracings of the vowels with those taken at the same time from a rapid tuning-fork. He found, like Wendeler, very great irregularity in the curves as compared with those of the vowels when sung; indeed, such great irregularity that no detailed results could be reached. The changes of pitch in the same enunciation were apparently without rule as to amount (the largest were an octave or more), direction, rate, or position on the curve. This great variability explains the difficulty of judging the pitch of the vowel tones and of reproducing them artificially. It may be an advantage acoustically, however, for it tends to obscure all tones except the over-tones near to the resonance-tone of the cavity of the mouth, and on these the recognition of the vowel depends. Changes in that cavity itself may also influence the form of the tracing. Experiments with a siren showed that the ear still perceives a *tone* rather than a noise when the pitch of a note is run down through an interval as great as that common in the vowel variations. The speaking voice seemed to be keyed lower than the singing voice, so far as tests could be made. The average length of a vowel tone was 0.182 sec., minimum 0.038, maximum 0.549. In the diphthongs the voice passes from one vowel to the other through a transitional stage that can be seen in the best tracings. When care is not taken in pronunciation the second vowel is apt to be slighted. The article is followed by full numerical tables and a plate giving some of the tracings and also plotted curves for the variations of vowel tones.

Second Report on Experimental Psychology: upon the Diagram Tests. Prof. C. S. MINOT. Reprint from Vol. I, No. 4, Proceedings Am. Soc. for Psych. Research, 1889.

The diagrams here tabulated were drawn in response to the following request: Please draw ten diagrams on this card, without receiving any suggestions from any other person, and add your name and address. Five hundred and one sets were received, 310 from men, 169 from women, and 22 without names. Eighty-three different figures are tabulated. The following are the first ten in the table of frequency given; the first number after each is the number of times it occurred; the one in parenthesis is the number of cards upon which the figure was found, some of the cards showing the same figure more than once: Circles, 209 (202, or 40 per cent); squares, 174 (168, or 34 per cent); equilateral triangles, 160 (153, or 31 per cent); crosses, 160 (124, or 25 per cent); letters, 82 (40); diamonds, 80 (79); horizontal oblongs, 78 (78); circles with inscribed figures, 78 (64); stars, 77 (65); faces with profile to the left, 61 (47). Classifying by larger groups, there were 287 circles of all kinds, 236 squares, 220 triangles, 245 four-sided figures, 149 other straight-sided figures—together more than one-fifth of the whole. The average places in the order of drawing (assuming that the figures were drawn from left to right as in writing), for the ten figures nearest the first are as follows: equilateral triangles, 2.6; squares, 3.2; right-angled triangles with hypothenuse left, 3.8; circles, 3.9; right-angled triangles with hypothenuse right, 4.1; faces not in profile, 4.4; faces profile to the right, 4.5; diamonds, 4.6; horizontal oblongs, 4.6; faces with profile left, 4.7. The figures drawn by the men showed a good deal more variety than those by the women. Some of the unusual diagrams are to be accounted for by the respondents having drawn what they habitually draw when scribbling; others by professional associations. Some were probably suggested by objects present, though most seem to have been of subjective origin. Ease of execution was generally a controlling factor. Like the association experiments of Cattell and Bryant below, these show the extent to which individual minds run in common and well-worn channels, and emphasize the error of supposing that a simple application of the calculus of probabilities fits such tests as those of thought-transference.

Favorite Numbers. ALBERT WILLIAMS, JR. Scientific American Supplement, March 16, 1889.

Another example of the number habit is here drawn from the United States Census of 1880. The ignorant who have to guess at their own ages, or to have some one else guess for them, are very likely to be set down in accordance with such a habit. The following are the numbers of persons between the ages of 28 and 42 reported for Alabama, where the negro population raises the percentage of ignorance, for Michigan, and for the whole country, given in thousands and tenths:

Age.	Ala.	Mich.	U. S.	Age.	Ala.	Mich.	U. S.
28	19.2	30.0	850.0	32	12.4	24.4	654.8
29	11.2	23.1	621.8	33	10.6	21.9	580.9
30	30.9	32.5	1,094.3	34	10.0	21.0	546.2
31	8.4	18.9	492.5	35	22.3	26.3	871.0

Age.	Ala.	Mich.	U. S.	Age.	Ala.	Mich.	U. S.
36	10.5	21.8	581.6	40	23.2	26.0	922.6
37	8.7	19.2	495.1	41	4.6	12.6	323.6
38	11.3	21.3	594.5	42	6.8	17.5	458.9
39	7.3	17.7	458.0				

There is an evident preference for the tens and fives, and one somewhat less marked for the even numbers, though those next the fives suffer by the greater attractiveness of the latter.

On the Nature of the Knee-jerk. WARREN P. LOMBARD, M. D. Reprint from the Journal of Physiology, Vol. X, Nos. 1 and 2.

Of the two opposing theories of the knee-jerk (that it is a direct result of the twitch to the quadriceps muscle, and that it is a full reflex process), the neat experiments of Dr. Lombard strongly support the second. The first has to assume what has yet to be proved, namely, a continuity of muscle-tonus and a dependence of the irritability of the muscle on its tension. The knee-jerk can apparently be present or absent without reference to the presence or absence of tonus, and artificial tension does not restore a lost knee-jerk. It can vary in amount independently of small variations in tension, and vary more rapidly than the irritability of the muscle. The first theory meets a difficulty in the reinforced knee-jerk because moderate reinforcing acts do not change the tension nor the irritability, and another difficulty in the fact, discovered by Mitchell and Lewis, that contractions produced by electrical stimulation cannot be reinforced. Moreover, not only the extensors, but occasionally the flexors also, respond to the stimulating blow—a fact not to be explained by direct stimulation.

A Contribution to the Study of Muscular Tremor. FREDERICK PETERSON, M. D. Reprint from Jour. Nerv. and Ment. Disease, Feb. 1889.

This contribution is in the nature of a preliminary study, intended rather to demonstrate a method than to present results. Twenty-five myograms taken in various nervous diseases with an Edwards sphygmograph, which the author recommends for such purposes, are given. The rates of tremor in most cases suffer some modification by the will of the patient, but they may be divided into two groups; one rapid and not far from 10 per second (the normal innervation rate according to Horsley and Schäfer), the other about half that rate. It would seem, therefore, that these diseases in some way make the muscle responsive to single impulses of innervation, or to groups of two or more. The myogram of the tremor of paralysis agitans has been shown by others to be dicrotic. Though recognizing the need of further investigation, the author is inclined to regard all except fibrillary tremors as of central origin.

Das Kopfschwingen. J. RICH. EWALD. Pflüger's Archiv, Bd. XLIV, H. 7-8-9.

By *Kopfschwingen* Prof. Ewald means the rapid from-side-to-side vibration of the head that can be voluntarily produced by taking a full breath and tensing up the muscles of the neck. With practice, the vibrations can be executed with those muscles alone, and give graphic

tracings almost as uniform as those of a tuning-fork, (for methods of registration, the original should be consulted). The average rate for the first second was 15–16, never more than 17; in a few persons of more than fifty years, less than 14½. In the same person it was constant, varying for Ewald himself only about half a vibration from the average. It could not be voluntarily changed, was not influenced by practice, and did not depend on the inertia of the head. The vibrations could not be kept up longer than 5–7 seconds, and grew slightly slower after the first second. They differ from tremors in regularity and constancy and in ceasing immediately when the head is fixed, which the fatigue tremor of the same muscles does not do. The author's explanation is that, by the contraction of one muscle and the accompanying movement, its antagonist is stretched, and the stretching makes it more excitable either directly, or reflexly as alleged for the knee-jerk. In trying to get tracings from the somewhat similar motions of the jaw when the teeth chatter, he failed because the attempt always inhibited the motions.

Ricerche di psicologia sperimentale. Prof. G. SERGI. Reprint from the Rivista sperim. di Freniat., Vol. XII, fasc. 4, 1886.

Professor Sergi here reinsists on an objection made by him to Wundt's conception of the central stages (perception, apperception and volition) in simple reaction-times, believing that under the usual circumstances of experiment the processes are not separable. The criticism does not, however, hold with full force against Wundt's present views, published since the appearance of Sergi's article; for in the last edition of his psychology he gives very great prominence to a shortened form of reaction in which the central processes enter but partially or not at all, and, like Sergi, speaks of it as purely reflex. Wundt's pupils have found this form of reaction with light, sound and electrical stimulation. Sergi reports it for sound only, but gives smaller values to it, and finds it under circumstances not admitted by Wundt. With his best subject he gets the following reaction-times:

	Uncorrected mean. s.	Corrected mean. s.	Maximum. s.	Minimum. s.
With signal,	0.070	0.0644	0.093	0.047
Without signal,	0.0577	0.0492	0.0655	0.034
" "	0.0725	0.067	0.0765	0.059
Barely perceptible sound,	0.0744	0.0688	0.083	0.054

In making the corrected means in the first and third series a single reaction from each was alone excluded; the maxima and minima seem to be for the corrected series. The values given by other experimenters for sound reactions range from 0.11 to 0.18.

Sergi also reaches results flatly contradicting two most widely accepted generalizations of psychometry, namely, that reaction-times with a premonitory signal are a good deal shorter than those without, and that reactions to strong stimuli are quicker than those to faint ones. In the table above there is no evidence of either. With other normal subjects he got for reactions without signal, series that ranged from 0.07 to 0.11, all as low or lower than those usually found with a signal; and with the faint sound, on the only other subject reported, he got an uncorrected mean of 0.097. The stimulus was a

bell stroke, and the time was taken with the chronoscope. The explanation of these results requires no more than an extension, to those cases where there are no aids to concentration, of the idea that concentrated attention can voluntarily set up a brain-reflex ; and Sergi seems to have been the first to suggest that idea. His results stand, however, so directly in opposition to previous results that skepticism is natural. It may be asked, for example, whether the starting of the chronoscope itself did not act as a signal ; and some chronographs also run slower for as much as three-quarters of a second after the throwing in of the hands (see C. S. Peirce, U. S. Coast Survey Reports for 1870, Appendix 21, p. 212). The subject is one worth further investigation. Wundt strangely seems not to have known of this paper when preparing the new edition of his psychology. E. C. S.

Recherches expérimentales sur la durée des actes psychiques les plus simples et sur la vitesse des courants nerveux à l'état normal et à l'état pathologique. A. RÉMOND. Paris : Octave Doin. 1888, pp. 135.

The author of this thick pamphlet has made 30,000 observations in all, on students, soldiers, old people, hemiplegics, and those suffering from myelitis, general paresis, epilepsy, hallucinations, delusions, hysteria, and muscular atrophy. He has plenty of "results" too, but unfortunately not of the decisive and convincing kind that might be hoped. The apparatus used was poor ; the chronoscope (*chronomètre de d'Arsonval*) must have been far inferior to the Hipp instrument, and the other arrangements, if fully described, were not up to modern requirements. The tables, though numerous, show only the maxima, minima and averages of the series, and not the average variations. The stimulus was tactile ; a certain portion of the hand, shoulder, ankle and hip were touched with a ball, a conical point and a needle. Discrimination-times were measured by using the ball and point in irregular order and requiring reaction to only one. The general conclusions reached are given for what they are worth. (1) The approximate speed of transmission in the sensory nerves in normal subjects is about 34.72 m. per sec. in the legs and 27.02 m. in the arms (determined by Schelske's method, *i. e.* by comparing reaction times for stimulated points unequally distant from the brain). The rate seemed increased in those of the aged affected with general atheroma, in hemiplegics (on the diseased side when there was secondary contracture), and in delirium of persecution. In all other cases the rate was diminished. (2) Motor conduction in the cord and nerves is quicker than normal in flaccid hemiplegia and in the presence of a disturbing noise, about normal with the epileptics, and slower with the other subjects. (3) The discrimination-time, normally 0.063—0.070 sec., is longer with a disturbing noise and for all the invalid subjects except the epileptics (with whom it is shorter), the hemiplegics with contracture when stimulated on the sound side, and the simply aged, with whom it is normal. (4) The simple reaction-time, found in the normal to be 0.1545—0.1587 sec., is shorter after taking phenacetine or antipyrine, and in old age with general atheroma, hemiplegia (on the sound side ; on the diseased side likewise with contractures), and in hysteria. (5) The reaction-time is regularly shorter for strong stimuli, except sometimes with the aged, hemiplegics, epileptics

and those with myelitis. (6) The psychic stage is the largest of those that make up the simple reaction-time, except with the epileptics, where it is exceeded by that of centrifugal conduction.

Mental Association investigated by Experiment. Prof. J. McK. CATTELL and S. BRYANT, D. Sc. Mind, April, 1889.

These experiments touch the question at two points: the time required, and the relative frequency of the different kinds. Three methods were used: one in which a printed word was shown, the word suggested called out, and the time accurately measured with apparatus; another, in which lists of ten words were shown, the word suggested by each called out, and the time for one found from the time for all; and a third, in which a word was pronounced and the subjects wrote down the words successively occurring to them in 20 seconds. None of these measure the bare process of association, and the second and third take in other processes; still it is possible by them to reach relative results of some certainty and to gather interesting statistics. The first method, used by Cattell and Berger, gave average association times of about half a second. The second method was used by the experimenters on themselves with very many words, and, with fewer, on a number of other people, including university graduates, students in a ladies' college and in a German gymnasium. The times found vary from 1.14 to 7.07 secs., the first for Cattell himself with concrete nouns, the second for the youngest boys tested at the gymnasium and with abstract nouns. The third was applied chiefly with London and Dublin school-girls. The oldest and most advanced averaged one association in 4.13 seconds, the youngest one in 9.33. Of the twenty nouns used, the English girls gave the greatest number in 20 seconds for "ship" (4.8), the least for "virtue" (2.3). The different series show that the association time is longer for abstract than for concrete nouns, and that maturity and mental discipline tend to reduce this difference.

Of fresher interest are the statistics of frequency. The first table, based on the associations of 465 persons with 10 concrete and 10 abstract nouns, gives the associations occurring ten times or over. The table averages less than eight associations per word, and yet contains more than half of all given—an evidence of the general uniformity of mental action in different individuals. All the associations with the words "house" and "time" were classified after a scheme like Wundt's, and showed, among other things, that most of the associations of co-existence were visual, like "house" and "garden"; most of those of succession were verbal, like "house" and "house-top." Treating in the same way a mass of over 12,000 observations from 512 persons, school-girls predominating, it appears that concrete nouns owe their associations a little more frequently to connection in sensation than to logical connection; that to go from whole to part, or to specialize, is much commoner than to go from part to whole, or to generalize; also that it is easier to go forward ("house" to "house-top") than backward ("house" to "glass house"), and easier to go to final than to efficient causes. The associations of abstract nouns, except verbal associations, are rarely due to the senses; about two thirds of the cases were correlations and specializations. Classifying again for observers, it appeared that those that write and teach prefer logical and verbal associations; two teachers gave respectively 33 and 26 per cent of verbal associa-

tions against about 1 per cent for their pupils; the favorite form for the latter was from whole to part. A further table shows the influence of the original word used, "tree," for example, suggesting "leaves" (whole to part), while "courage" suggested its like or its opposite. By no means the least interesting part of the research, and one contributing greatly to the proper conception of the results, is the appendix of subjective observations by the experimenters and several of their subjects.

(1). *Untersuchung über die Latenzdauer der Muskelzuckung in ihrer Abhängigkeit von verschiedenen Variabeln.* Dr. ROBERT TIGERSTEDT. Archiv für Anat. u. Physiol. (Physiol. Abth.), 1885, p. 111.

(2). *Die Scheinbare Latenzperiode der Erregung bei directer Muskelreizung.* Dr. EMERICH NAGY v. REGÉCZY. Pflüger's Arch., Vol. 43, p. 584.

(3). *On the Normal Duration and Significance of the "Latent Period of Excitation" in Muscle-contraction.* G. F. YEO. Jour. of Phys., Vol. IX, p. 396.

Helmholtz in 1850 discovered that a period of time elapses between the moment of stimulating a muscle and the commencement of the ensuing contraction. He found this latent period to be approximately 0.01″, and thought that submaximal shocks, as well as loading, overloading and fatigue, caused this value to vary. He did not attempt to explain the meaning of this lost time, and even thought it possible that contraction might begin immediately on stimulation.

Since 1850 other investigators have variously estimated the latent periods within very wide limits; but after the researches of von Bezold and Bernstein, a duration of 0.01″—0.02″ seems to have been universally accepted as the normal period, coupled generally with the view that this time is consumed by certain molecular changes prerequisite to contraction.

In 1879, however, Gad combated this opinion, and was led by Bernstein's work, which showed the latency of the electric changes of the muscle preceding contraction to be about 0.001″, to regard the latency of the individual muscle elements as of similar amount. He pierced the belly of the muscle with a recording lever, and, upon stimulating the lower end, obtained a curve indicating an initial lengthening of the muscle before contraction began. He considered this as evidence that when the muscle is stimulated, the muscle elements originate a local contraction and stretch their fellows more remote. According to his view, therefore, the latent period is the time required for the contraction to include a number of muscle elements more than sufficient to compensate the initial elongation. Since the whole must be greater than any of its parts, he maintains that the latency of the individual elements must be less than that of the whole muscle.

(1). In *du Bois-Reymond's Archiv* for 1885, Robert Tigerstedt gave the results of his research upon the latent period. As had been conceded before him, he found that temperature was an important condition, and concluded that the latency from 12°—16°.9 C. is 0.006″; from 17°—18°.9, 0.005″; and from 20°—29° C., 0.004.″ Bernstein had discovered that the impulse from nerve to muscle was delayed in the nerve endings 0.0032″. Tigerstedt, who adopts 0.002″ instead of 0.0032″, notes that in direct maximal stimulation of an uncurarized muscle, in consequence of this delay, there are

two waves of excitation—one proceeding from the muscle substance directly, and another from the nerve endings, and these waves may summate. If curare is not administered, the latency is longer and maximal contractions are at times obtained with much weaker shocks; but if the endings are thrown out of action by curare, the latency is not dependent upon the shock. The latency within normal limits is independent of the tension of the muscle.

Taking up the line of thought pursued by Gad, he declares that many muscle elements must be active before a contraction becomes manifest, and that without doubt the latent period of these elements is less than that of the whole muscle. The latent period of the muscle, according to him, is the time taken up by the wave of contraction, which begins at once, or very soon after the stimulation, to traverse a sufficient length of muscle (12 mm.) to render the contraction perceptible.

(2). In his article in *Pflüger's Archiv*, Vol. 43, Regéczy seems to have accepted the work of Gad and Tigerstedt without qualification, and boldly speaks of the "apparent" latent period. He finds that the muscle curve generally rises earlier if the excitation starts from the lower end than if from the upper one, and that the duration of the latency varies inversely as the thickness and length of the muscle. When the stimulation falls in simultaneously at both ends of the muscle, the latency is longer than when the middle of the muscle is stimulated, because more resistance and more stretching are encountered. In short, he believes that all conditions influencing the period begin in affecting the stretching, and were it not for this, no latency of the excitation would exist.

(3). To this view of Gad, Tigerstedt, and Regéczy, Yeo takes exception. He maintains that it not only disagrees with all that we know of contractile tissue, both animal and vegetable, but also that it has not been definitely proved. Concerning the latent period, however, he admits that the old estimate of 0.01″ is certainly too high, and thinks that 0.0065″ is more accurate. In general, his results seem utterly at variance with those of the three investigators just mentioned. In the first place, contrary to Tigerstedt's view, he declares the latency to be prolonged by increase of load; and in regard to stimulation he says, "It would seem that the latency varies with changes of intensity of stimulation, even when the nerve terminals are paralysed [by curare] and the stimulations are maximal." He finds Gad's curves are very easy to get, not only as Gad did, by stimulation of the lower end, but also by stimulating the muscle throughout its whole length, and that with any direction of current; by using the electric signal for marking the beginning of the contraction, he affirms that the elongation occupies the second half of the latent period of the half muscle, and hence cannot, as Gad supposed, be the cause of the latent period. He concludes from his work upon this point, that a preliminary elongation does take place at times, when the latency is recorded by a lever transfixing the belly of the muscle, but that it might be due to the non-recognition of the earliest contracting efforts, while the heavy direct weight quickly indicates increased extensibility of the tissue; or it might be "that the transfixing needle and electrodes cause some polarisation, and consequent slight tonic contraction, which may be inhibited on stimulation." Again, if Tigerstedt's view be right, viz. that the latent period is the time required for the wave of contraction, which starts immediately after stimulation, to travel over a certain dis-

tance before the contraction is able to show itself, then the latency of the part of the muscle where the shock is sent in should be little or nil; yet Yeo obtained nearly the typical latency under such circumstances. The author concludes that "the latency of the individual muscle elements is a theoretical speculation which appears difficult to determine by experimental methods, and which I feel disinclined to investigate. Graphically I think it cannot be shown to be shorter than that observed at the actual point of stimulation—*i. e.* nearly .005″."

What is wanted is plainly more work, and such work as will fill up the gaps in the researches now extant. Thus, to mention some of the more obvious defects, Gad does little more than state his results; Tigerstedt, generally very satisfactory and explicit, fails to give the name of the muscle used by him, although it is known that the degree of regularity of form of the muscle is of considerable importance; and Yeo, while finding fault with Tigerstedt for employing hypermaximal and injurious stimuli, seems possibly himself at times to have made use of submaximal shocks.

It is interesting to compare the various numerical values of the latent period found from time to time by different observers. The excellent table of Yeo is used as a basis for the following:

1850.	Helmholtz,	.01″	1877.	Lautenbach,	.008″
1859.	Harless,	.0187		Brücke,	.007
	Bezold,	.0136		Gad,	.004
	Wundt,	.01	1879.	Sewall,	.01
1862.	Fick,	.007		Richet,	.008
1867.	Place,	.005		Langendorf,	.009
1868.	Marey,	.01		Mendelssohn,	.008
	Klunder and Hensen,	.0085	1883.	Cash and Yeo,	.009
	Lamansky,	.0075		Rosenthal,	.009
1870.	Volkmann,	.01	1885.	Fredericq,	.018
1871.	Valentine,	.021		Tigerstedt,	.005
	Bernstein,	.0188	1888.	Regéczy,	.0033
1874.	Ranvier,	.015		Yeo,	.0065

EDW. C. APPLEGARTH.

Die Theorie der Muskelcontraktion. G. E. MÜLLER. Nachrichten von der Königlichen Gesellschaft der Wissenschaften und der Georg-Augusts-Universität zu Göttingen, No. 7, March, 1889.

As the whole question of the latent period is intimately connected with the obscure problem of muscle contraction, perhaps the elaborate theory of contraction recently formulated by Müller may be of interest here.

This author, discarding the views of Krause, Merkel, and Engelmann, starts out with three fundamental, constituent elements of the muscle fiber, which he designates *disdiaklasten*, *gerüstsubstanz*, and *muskelsaft*. The disdiaklasts (Brücke's term for the doubly refracting particles of the muscle) are here elongated aggregates of such particles or micellae, so arranged that their long axes are parallel to that of the fiber. Running from one end of the fiber to the other there are series of cross columns of these disdiaklasts at the level of the anisotropic bands, the individual disdiaklasts of each column being united laterally with their neighbors by little crosswise rods or threads (*querbälkchen*) forming a network, and longi-

tudinally, that is across the isotropic bands, with the corresponding disdiaklasts of the succeeding cross column by somewhat similar little rods of lengthwise disposition (*längsbälkchen*). The series of disdiaklasts so joined together by the *längsbälkchen* are the fibrils, and these together with the network of *querbälkchen* constitute the *gerüstsubstanz*. All the remaining space within the sarcolemma is filled with *muskelsaft* or muscle plasma, and it is in this substance that the heat production takes place during activity of the muscle.

He supposes that contraction is some such process as this. By anabolism, a store of energy is laid up, which is partly converted into heat upon stimulation of the muscle. Owing to their nature and form considered crystallographically, the disdiaklasts are pyro-electric, and from their arrangement in the fiber the neighboring ends of the disdiaklasts of consecutive cross columns will contain electricity of opposite signs, the effect of which will be to pull the elements from a longitudinal to a transverse position. This tendency, however, will be resisted chiefly by the *gerüstsubstanz*, but also by the sarcolemma, the perimysium, etc. To the opposition so engendered he applies the name *inner-contraction-resistance*. The cross and lengthwise rods differ in structure microscopically. The lengthwise rods are firmer and less capable of swelling than the crosswise rods, which are full of so-called *functional pores*, whose duty it is to absorb the surrounding plasma. When the crosswise rods are stretched lengthwise, as is the case when the disdiaklasts are forced into their transverse position, their capacity for the plasma is increased, so that the muscle on contracting shortens and swells, not simply on account of the change of position, but also because the *querbälkchen* become very turgid. Now when the electric charge of the disdiaklasts sinks to a certain limit, the retention of plasma, in consequence, is discontinued, but the process of expulsion is comparatively slow, due to inadequate elasticity. The return of the disdiaklasts to their normal position being thus retarded, the relaxation is somewhat prolonged.

He puts great stress upon the following myothermal law, which is conceived to be fundamental: "The heat production which takes place in consequence of a given stimulus in a particular part of the plasma, is so much less, the higher the pressure is, under which this part of the plasma is." Indeed, as much depends upon the plasma as upon the electric charge of the disdiaklasts. Thus to make an application, he says, the tension which a muscle possesses at any given time depends not simply upon the electric charge then present, and upon the length of the muscle at that moment, but also upon the value of the *functional imbibition pressure*, or the pressure which the plasma in the functional pores supports. Again, when products of muscle activity accumulate, they increase the consistency of the plasma, which then opposes any change of form of the muscle, and at the same time lessens the rate of transmission of the excitation. The advantage of the circulation is, then, in maintaining the low consistency. In another place, speaking of the plasma, he says, through every stimulation the irritable material, or the quantity of the irritable molecules of the plasma, through whose decomposition the production of heat is effected, is lessened according to the measure of intensity of the excitation. This serves naturally to weaken the influence of the following stimulus.

Müller applies his theory very deftly, and the whole thing

possesses a degree of plausibility, but still there are no facts as yet to substantiate it, and in the absence of these it is well to await developments, especially as he gives this paper simply as a preliminary communication. E. C. A.

III.—ABNORMAL.

A FEW PRACTICAL SUGGESTIONS TO PHYSICIANS IN ASYLUMS, HOSPITALS, ETC., FOR THE OBSERVATION OF PATIENTS SUFFERING FROM MENTAL OR NERVOUS DISEASE.

I.

The following suggestions are made with the view to getting data beyond those strictly necessary for diagnosis, since such data would be extremely valuable both from the psychological standpoint and as a basis for determining the function of diseased parts, should the case come to autopsy.

How to observe.—Patient should be away from all distractions, in a room apart, and at ease—as a rule, either sitting or lying down, and with the mind placid. Experiments should rarely last an hour, as the attention is easily fatigued. Successive observations should be made at the same time of day. For experiments not involving the eyes it is best to have the patient thoroughly blindfolded.

Records.—May be written, or in some cases, *e. g.* areas of anaesthesia, plotted on an outline of the body, such as may be copied from any anatomy.

In progressive disease, a careful study of one patient has more value than a casual study of several.

Beginning with the skin sensations.—Is the sense of contact anywhere absent? Where? If present, test "discriminative sensibility" with compasses. For a table of the normal discriminations in various regions see Foster's *Text-book of Physiology* under "Tactile Sensations." Compasses should be made of a substance non-conductive of heat, and slightly blunted at the points, like the rounded end of a small needle. The best form is that where one point is fixed and the other slides along an arm (at right angles to the first point) on which a scale is marked so that the distance between the points is easily read off. See *Aesthesiometer*, by J. Jastrow, AMERICAN JOURNAL OF PSYCHOLOGY, Vol. I, p. 552.

Sense of location.—The patient to touch a spot on his body which the observer is touching.

Temperature sense.—Discrimination of differences. Two objects—preferably thermometers with large bulbs—the temperature of which is known, are touched successively to the same spot on the body and the patient required to distinguish between them.

Sensibility to heat and cold.—Test by applying metal points suitably warmed or cooled. If these sensations are dull, the area stimulated must often be large, a square inch or more, to get any reaction at all. Refer to *Eine neue Methode der Temperatursinnprüfung*, Dr. A. Goldscheider, Archiv für Psychiatrie und Nervenkrankheiten, Bd. XVIII, Heft 3, 1887. *Research on the Temperature-sense*, H. H. Donaldson, Mind, No. XXXIX, 1885.

Those cases in which the sensation for one sort of temperature stimulus remains while that for the other is absent, are specially important.

Motion on the skin.—By drawing a point up or down the skin of a limb, to determine whether the direction can be recognized. Refer to *Motor Sensations of the Skin*, by G. Stanley Hall and H. H. Donaldson, Mind, No. XL, 1886.

Pressure.—By placing weights successively on the same spot, the patient to detect the difference between any pair of weights. Such weights can be easily made by loading paper cartridge-shells with various charges of shot.

Tickling.—It is specially important to determine the conditions under which this disappears.

Muscle-sense.—Discrimination of weights. Weights to be lifted and thus distinguished. Mr. Francis Galton has a set of weights for this purpose. See *On Apparatus for Testing the Delicacy of Muscular and other Senses in Different Persons*, by Francis Galton, F. R. S., Journal of the Anthropological Institute, May, 1883. A brief account of this is given in *A Descriptive List of Anthropometric Apparatus, etc.*, published by the Cambridge Scientific Instrument Co., Cambridge, England. Other apparatus, to be mentioned later, is described in the same publication, and I shall refer to this catalogue in these cases simply as the "descriptive list."

With paper cartridge-shells filled with shot, the more elegant apparatus of Galton can be fairly imitated.

Position of limbs.—To imitate with a sound limb the position in which the affected limb is placed, or the reverse. Eyes closed.

Clonus, Knee-jerk. See *The Variations of the Normal Knee-jerk and their Relations to the Activity of the Central Nervous System*, Dr. Warren P. Lombard, AMERICAN JOURNAL OF PSYCHOLOGY, Vol. I, 1887.

Vision.—Ophthalmoscopic data. Pupillary reactions. In case of paralysis of the external ocular muscles, the subjective sensations of motion on innervation of the paralyzed muscles.

Field of vision.

Field for various colors. For this, some sort of a perimeter is needed.

Color blindness. Some system of colored wools is the simplest device for this purpose.

Visualization. Number-forms, etc. See *Inquiries into Human Faculty and its Development*, Francis Galton, F. R. S., Macmillan & Co., 1883.

Hearing.—Limits of audition, by means of a small whistle. See "Descriptive list."

Appreciation of pitch. For specially constructed organ-pipe see "Descriptive list."

Colored sounds. Associations of certain colors with given tones. Refer to *Zwangmässige Lichtempfindungen*, Lehmann and Bleuler. *Inquiries into human faculty*, &c., Francis Galton.

Time sense. Repetition and maintenance of a given tempo. This involves the use of some device by which a graphic record can be obtained—a revolving drum, for example. Refer to a series of articles in *Wundt's Studien* under the title "Zeitsinn."

Smell.—Its delicacy, by means of standard solutions of graded strength.

Taste.—Test different portions of the tongue for bitter, sweet, acid, and salt. For bitter and sweet the test can now be made with accuracy. See *Note on the Specific Energy of the Nerves of Taste*, by W. H. Howell and J. H. Kastle, Studies from the Biological Laboratory of the Johns Hopkins University, Baltimore, Vol. IV, 1887.

Equilibrium sense.—Special susceptibility to dizziness on whirling, etc. These facts bear on the functions of the semi-circular canals. See *The Sense of Dizziness in Deaf-Mutes*, American Journal of Otology, Boston, 1882, by W. James.

Generative organs.—Cremaster reflex. Prepuce: does it cover glans? Perverted sexual instincts; refer to von Krafft-Ebing, *Perversion of the Sexual Instinct; Report of Cases.* (Translated by H. M. Jewett, Alienist and Neurol., St. Louis, 1888, Vol. IX). Dreams; refer to Julius Nelson, *A Study of Dreams*, AMERICAN JOURNAL OF PSYCHOLOGY, Vol. I, No. 3.

Reaction time.—To get valuable results, some apparatus is needed. The simplest is that described by Joseph W. Warren, M. D., in a paper *On the Effect of Pure Alcohol on the Reaction Time, with a Description of a New Chronoscope*, Journal of Physiology, Vol. VIII, 1887. The "Hipp Chronoscope" is a somewhat costly instrument, to be used only with great caution. For the conditions attending its use see *Psychometrische Untersuchungen*, by J. McK. Cattell, Philosophische Studien, edited by Wundt, Vol. III, 1886. There is further a way of recording the reaction time on a revolving drum, such as is used in astronomical observatories.

Aphasia.—See *Aphasia*, by Dr. M. Allen Starr, Transactions of the Congress of American Physicians and Surgeons, Vol. I, 1888; and Kussmaul, in Ziemssen's Cyclopaedia, XIV, pp. 581–875. Refer to *Versuch einer Darstellung unserer heutigen Kenntnisse in der Lehre von der Aphasie*, Ernst Malachowski, Volkmann's Klin. Vorträge, No. 324.

Handwriting.—Refer to *Die Schrift*, von Dr. Albrecht Erlenmeyer, Stuttgart, 1879. *On the Writing of the Insane*, by G. Mackenzie Bacon, M. D., London, 1870.

Muscles.—Exact determination of muscles affected in paralysis. Very important for getting the motor centers in the spinal cord.

II.

Mental derangement.—Study of the incipient stages and the central point of the alienation. See *Insistent and Fixed Ideas*, Edward Cowles, M. D., AM. JOURNAL OF PSYCHOLOGY, Vol. I. *Paranoia*, William Noyes, M. D., AM. JOURNAL OF PSYCHOLOGY, Vol. I. *Extract from the Autobiography of a Paranoiac*, Dr. Frederick Peterson, AM. JOURNAL OF PSYCHOLOGY, Vol. II, No. 2, 1889.

III.

Removal of central nervous system.—Dura to be left at points where it is at all adherent. If the brain is to be used for microscopic examination, injection of it through the aorta with 2 per cent bichromate of potash removes blood and facilitates hardening; not permissible, of course, where hemorrhage is suspected.

DO NO

The cord can be removed from the ventral side by chipping off the bodies of the vertebrae with broad chisels specially made for the purpose, or dorsally, by sawing through the arches of the vertebrae with a double saw (made by Luer, Paris), or by the common chisel. The spinal ganglia should be removed whenever possible; also sympathetic ganglia. Bits of peripheral nerve should be tied out straight on a bit of wood or cork before being put in the hardening fluid. Refer to v. Bischoff's *Führer bei den Präparirübungen*, etc., edited by N. Rüdinger, München, 1886.

The form of the brain is best preserved by receiving it in a jelly mould padded with moist cotton; by the use of two such moulds it can be turned over with little distortion.

In taking the weight it should be noted what membranes are on; how much of the cord is attached; whether the fluid has been removed from the ventricles, etc.

For the convolutions Ecker is the most desirable authority, having been accepted in the current text-books. Refer to *Die Hirnwindungen des Menschen*, etc., von Alex. Ecker, zweite Auflage, Braunschweig, 1883. There is a translation of the above (1st edition) by R. T. Edes, New York, 1873.

In sectioning the brain.—First, open the lateral ventricles by a median section a few millimeters to one side of the middle line. This empties the ventricles of fluid. All cuts to be made with one sweep of the knife, giving a smooth surface. In the case of the hemispheres, cut from the middle line outwards, thus leaving the pieces bound together by the pia in such a manner that after the sectioning is over the convolutions can be reconstructed. For details, see *Die Sections-Technik*, etc., von Rudolf Virchow, dritte Auflage, Berlin, 1884.

The records of lesions are made much clearer by a sketch. Lebon & Co., 23 Southampton Buildings, Chancery Lane, London, W. C., England, furnish sets of typical sections of the brain printed on gummed paper. On these the lesion can be indicated and the sketch then pasted in the record book.

Preserving material.—The brain and cord are best hardened for most purposes in potassium bichromate, 2 per cent. The quantity must be large at first and often changed. A brain should not be put in less than one gallon of bichromate, and this should be changed as often as it becomes turbid, say 6–10 times. During hardening in bichromate the specimen is best kept at a moderately low temperature, say 40°–50° F., and in the dark. The strength of the solution may be gradually increased to 4 or 5 per cent in the later stages of the process. When the material is hardened it is firm yet springy, and cuts in thin sections with a razor without having the sections break. The length of time requisite for this ideal condition varies with the part of the nervous system, the strength and quantity of the bichromate, the freshness of the specimen, and the temperature. For an entire brain it may vary from 6 weeks to 3 months or more. Where the material is soft through post-mortem changes, hardening can be obtained by adding ¼ per cent copper sulphate to the bichromate solution. The specimen being hardened, it must be thoroughly washed out in cold running water. This may take 3 or 4 days in the case of an entire brain. The specimen may then be preserved indefinitely in strong camphor

water or 80 per cent alcohol. In camphor water it should be watched, to make sure that no mould forms on it. Brains preserved in camphor water are to be preferred for further microscopic study.

Refer for description of the finer anatomy to *Anleitung beim Studium des Baues der nervösen Centralorgane im gesunden und kranken Zustande*, von Dr. H. Obersteiner, 1888. An English translation of this book is promised soon.

In addition to the books and articles mentioned above, the following may be referred to as embodying recent advances in the field of physiological psychology and as illustrating the value of experimental and clinical data to psychology: *Grundzüge der physiologischen Psychologie.* W. Wundt. 2 vols. Leipzig, 1887.—*Elements of Physiological Psychology.* Geo. T. Ladd. New York, 1887.—*La Psychologie physiologique.* G. Sergi. Paris (a translation from the Italian).—The following monographs of Ribot's (F. Alcan, Paris) are popular, but are to be recommended for a general view of the subjects treated: *Les maladies de la mémoire; Les maladies de la volonté; Les maladies de la personnalité; La psychologie de l'attention; La psychologie allemande contemporaine.* Most of these have been translated; the first forms one of the International Scientific Series; the next two are, I believe, in the "Humboldt Library," and the last is published by the Scribners under the title of "German Psychology of To-day."

It would yield the best results if any one interested in work of this nature would settle on some single topic and pursue that specially. As the above lines are merely suggestions, the author will most gladly answer any further questions that may arise regarding methods or apparatus. Pathological nervous material which may be consigned to the author will be examined and reported on with all due promptness. HENRY H. DONALDSON.

CLARK UNIVERSITY, *June*, 1889.

Ueber optische Aphasia und Seelenblindheit. C. S. FREUND. Archiv f. Psychiatrie, Bd. XX, H. 1 und 2.

The connection of aphasia with disturbances in the visual centers has been noticed by several observers, and Wilbrand has touched on the probable explanation. Dr. Freund's object is to show that this "optical aphasia" is a distinct and independent kind. The seven cases which he gives (two of his own observation and five from the literature), allow the following general description. All showed cerebral defects of vision; in 4 right hemianopsia was demonstrated, in 1 (left-handed) left hemianopsia; and similar trouble was doubtless present in the other two. In five there was psychic blindness. Satisfactory tests for agraphia and alexia were wanting in most. The distinctive disturbances of speech were in all more or less clearly connected with the visual defects, the differences coming chiefly from the degree in which the "optical aphasia" was overlaid by the other kinds. In the simplest cases there was loss of nouns (their place being frequently taken by circumlocutions) and of the ability to name objects. At least two of the cases were helped by handling what they were to name; and to one words not to be given at request sometimes recurred spontaneously. The results of section, in the six cases in which it was made, show extensive lesions, generally in the occipital and tempero-occipital

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lobes. Bilateral lesions were associated with psychic blindness, unilateral not.

The connection of these lesions with the language symptoms and others is made clearer by reference to a schema. It is to be supposed that the two visual centers in the left and right occipital lobes are connected by lines of fibers with the speech centers in the left temporal and frontal lobes, and by other lines, in which half of each retina is represented, with the eyes. Of the many possible lesions of these centers and tracts, three are of interest in this connection, namely, (1) the cutting of the fibers between the left visual center and the eyes and of those between the right visual center and the speech centers; (2) destruction of both visual centers; and (3) destruction of the left visual center and cutting of the fibers between the right visual center and the speech centers. (1) The first would represent the purest cases of "optical aphasia." The cutting of the first set of fibers would produce right hemianopsia and prevent the left visual center from receiving new visual impressions. Its connection with the speech centers would, however, still be in function and its optical memory images available for speech. The cutting of the second set of fibers would prevent the use in language of the images belonging to the right center. Now for undisturbed speech it is necessary not only that the sensory and motor images of the word, but also that those that form the concept of the thing for which the word stands, and the connections of the two sets, be intact. In spontaneous speaking there would be temporary difficulty in finding the nouns corresponding to new visual images (recorded only on the right side) or to the sense impressions of the instant. The patient would be unable to name objects shown him, though he could point them out when named, because the uninjured connections of the visual center with the other sensory centers would enable him to form full and concrete concepts of objects. In the same way naming would be facilitated by handling the objects, and there would be no psychic blindness. (2) The symptoms of the second kind of lesion would be total psychic blindness. The concepts would lack all their visual part, would be less concrete, the course of thought would thus be disturbed and consequently speech, while all the time the speech centers proper remained intact. Touch would give no help here. (3) The third kind of lesion would show right hemianopsia, non-recognition of objects formerly represented only in the left visual center, *i. e.* right-sided psychic blindness. Those represented in the right visual center could be recognized, but not named. Objects named could be pointed out and the patient would be helped by touch in naming, as in the first case.

The author concludes his paper with a general consideration of psychic blindness (of which he records an additional case in the first part of the paper), pointing out among other things that psychic blindness may result from a cutting of all the association fibers of the visual centers even when the cortex and its connection with the eyes are uninjured. Freund's cases greatly resemble a case reported in the *Neurolog. Centralbl.* No. 17, 1888 (see abstract, AM. JOUR. PSY. Vol. II, p. 175), by Bruns and Stölting, who came to very similar conclusions as regards the explanation of the disturbance. In a review in the same periodical, No. 4, 1889, Bruns brings out the points of divergence.

Ein Fall von Seelenblindheit. Dr. LISSAUER. 48. Sitzung des Vereins ostdeutscher Irrenärzte, Nov. 1888. Allg. Zeitschr. f. Psychiatrie, Bd. XLVI, H. 1.

This case is very like those of Freund. The patient was an old man, with no previous trouble beyond attacks of dizziness and senile weakness of memory. On examination he showed no aphasia nor symptoms of paralysis; right hemianopsia; sight in the center of the field preserved, and amounting to $\frac{1}{4}$ to $\frac{1}{2}$ normal; inability to recognize the significance of objects shown or to name them, except with aid of other senses, *e. g.*, touch or hearing; alexia without agraphia; ability to draw outlines of simple objects, but without recognition. The author distinguishes two kinds of psychic blindness, an apperceptive and an associative, caused respectively by injury to the visual centers or to their associative fibers—in this case, since the patient recognized forms, probably the latter.

Ueber Aphasia. LEOPOLD CARO. Inaug. Dis. Arch. f. klin. Med. Bd. XLIII, 1888. Abstract by Sperling in the Neurol. Centralbl. No. 4, 1889.

As an appendix to the body of his dissertation (in which he presents the doctrine of aphasia and his views on the origin of language), the author reports a carefully studied case, in which, as in one of Grashey's, the aphasia rested on a general decline of mental power —a case of amnesic aphasia. The mental processes of the patient were surprisingly slow; six or seven seconds were required for the recollection of his own name, as much as twenty for seeing and naming objects. He himself said: "When I look at the picture, then I don't know—know what it is; I have to—have to look at it closely first, then I have to—have to think over what it is; then what—what it is called." He took four seconds longer to read capital letters than small, though, as it would seem, the reading of letters in series was not delayed. Some letters, especially capitals, could not be written at dictation and generally were not recognized; the figures above 3 also failed of recognition. What the patient did read he did not at once understand. Some questions elicited no answer, from lack of comprehension, and frequent repetition was required. All sense perceptions were soon forgotten, and smell and touch were dull. As in Grashey's case, the patient was unable to read even short words when obliged to take them letter by letter, because the first was forgotten before the last was recognized; for example, "Ochs" could not be read when written with the letters a good deal separated. He could not tell the number of three pencils when they were some distance apart, nor count the sides of a polygon.

L'Alcoolisme, étude médico-sociale. Dr. E. MONIN. Ouvrage couronné par la Société française de Tempérance et précédé d'une Préface par le Dr. Dujardin-Beaumetz. pp. 308. Paris, Octave Doin, 1889.

The aim of this book is to popularize scientific information on the subject with which it deals, and as a popular book it is readable and valuable. The headings of its ten chapters give its scope: Chronic and Acute Intoxication [ivrognerie, ivresse]; The Diseases of Drinkers; The Extent of Alcoholism, its Pandemic Expansion; Alcohol and the Nervous System; Responsibility of Alcoholics; Action

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of Different Beverages, Distilled Liquors; Absinth; Common Fermented Beverages; Dipsomania; Preventive and Curative Remedies. Under each of these heads is gathered interesting information. Dr. Monin has little liking for what he regards as impracticable total abstinence. What he hopes to see, and what the French Society of Temperance endeavors to secure, is a hygienic use of pure beverages of the less alcoholic kinds. To this end the author would look to government for help in such preventive measures as the betterment of conditions which force the lower classes to drunkenness, the use of the taxing power in favor of the less harmful liquors, and especially the prevention of poisonous adulterations. The state, however, can do comparatively little; measures of social reform, temperance teaching in the schools, temperance societies, coffee-houses, etc., have an important place. For the cure of confirmed drinkers he favors inebriate asylums as in operation in this country. In the last section of this chapter he points out the general lines of medico-pharmaceutical treatment, and gives prescriptions that have been found advantageous.

Ivrognerie, ses causes et son traitement. Dr. P. J. KOVALEVSKY. Translation into French by Woldemar de Holstein, M. D. Kharkoff, M. F. Sylberberg, 1889, pp. 113.

This little book, by the professor of nervous and mental diseases at the University of Kharkoff, is limited more strictly than the last to the statement of present views of inebriety as a disease. The subject is treated under the heads of Symptoms of Inebriety, Prodromal Period, Chronic Alcoholism, Dipsomania, Predisposing Causes of Inebriety (heredity, sex, age, religion, nationality, climate, disease, etc.), Provocative Causes (psychic and physical traumatism, disease, profession, climate, etc.), and Treatment. The author presents his views with admirable clearness, and seems to have succeeded in being popular without sacrifice of quality or form. He recognizes the necessity of a strong foundation in educated public opinion in dealing with the question practically, and, unlike Dr. Monin, would not be opposed to suppressing the sale of alcohol entirely except for medicine and the arts. Even as medicine he would have it used with caution. This difference comes apparently from his much greater familiarity with American and English studies of the subject. Inebriety in the individual is to be treated as a disease; the author has, however, little faith in the various specifics that have been recommended. The hereditarily disposed should have preventive treatment, moral and medical. Those in whom the disease is established should have the discipline of special hospitals (not jails nor insane asylums), where the necessary physical and moral rebuilding of the man can be carried out. As single items among others, manual training and work in the open air are recommended.

Experimentelle Untersuchungen zur Lehre vom chronischen Alcoholismus. F. STRASSMANN. Eulenberg's Vierteljahrss. f. grichtl. Medicin u. s. w. Abstract by Joseph in Centralblatt f. Physiol. No. 24, 1889.

Twelve dogs were treated by the author to determine the difference in the effects of the chronic alcoholism produced by pure alcohol and by that adulterated with higher members of the series. Practically the only constant results due solely to the alcoholization were

chronic catarrh of the stomach and fatty degeneration of the liver. The addition to the spirit of 3 per cent of amyl alcohol increased the disturbances and caused death in less than half the ordinary time; and 1 per cent aggravated single symptoms, not however sufficiently to hasten death.

The Etiology of Dipsomania and Heredity of "Alcoholic Inebriety." LEWIS D. MASON, M. D. Quarterly Journal of Inebriety, Oct., 1888.

Dr. Mason gives the testimony of a large number of physicians, including noted specialists, as to the neuro-psychic degenerations in the offspring of alcoholic parents, and has added tables of 600 cases treated at the Inebriates' Home, Fort Hamilton, N. Y. Of the 600 cases, 265 showed inebriate ancestry, distributed as follows:

Fathers	168	Brothers	16
Mothers	9	Grandfathers	12
Fathers and other relatives	32	Grand-parents	2
		Other relatives	26

Thirty-eight showed insane ancestry. In 501 of the 600 the tendency to inebriety appeared between the ages of 15 and 35, in 294 between 15 and 25. Dipsomania is perhaps individually acquired and may result from traumatism, but is generally inherited; there is therefore justification for the term "inebriate diathesis."

In the same number of the *Journal of Inebriety*, Dr. T. L. Wright gives testimony from the English alienists on the same question, and in a third article is gathered a portion of the replies to a question sent out to physicians by the same journal as to the liability of the descendants of inebriates to inebriety, insanity, phthisis, etc.

Inebriate Asylums and their Work. T. D. CROTHERS, M. D.

This pamphlet is part of a lecture before the Y. M. C. A. at Toronto, by one of the foremost representatives of the disease theory of inebriety. The author sketches briefly the history of that theory, the history and present conditions of asylum work, the classes of patients that come and the plan of treatment. In conclusion he mentions some general principles of management, and points to the future before such institutions.

The Question of Responsibility in Inebriety. T. D. CROTHERS, M. D. Alienist and Neurologist, January, 1889.

Four lines of examination will throw light on the question: (1) as to the periodicity of the drinking spells; (2) the immediate connection of alcohol with the crime, its lack of motive, the manner of its execution; (3) the cause of the inebriety—traumatism, etc.; and (4) heredity. When the indications from these concur, insanity and irresponsibility are tolerably certain. The real test is not knowledge of right and wrong, but power of control, which is often to be determined only by careful study of the case. Inebriety is itself a sign of lack of control. In general, all inebriate criminals are of unsound mind. The limits of responsibility cannot be drawn in such a hazy border-land of insanity, and the burden of proof should rest on those that hold the inebriate to be sane.

DO NOT REM

Die Heilung der durch Morphiumgenuss verursachten Nervenzerrüttung und Willensschwäche. Dr. CONSTANTIN SCHMIDT. 2. Aufl. pp. 48. Berlin und Neuwied: Heuser, 1888.

Sudden dishabituation has, in Dr. Schmidt's opinion, little to recommend it and very much to condemn it. The attempt to cure by substituting cocain is little better. His own plan is gradual reduction, with moral as well as physical treatment. On the psychic part—the rebuilding of the will and the preservation of self-respect—he lays much stress. His first aim is to reduce the amount to the least on which the patient can endure life, say 2–3 cgm. Relations of the utmost confidence between physician and patient are to be cultivated. Dr. Schmidt would not at once take away the patient's syringe, though he would urge the cessation of self-injection. He would not reduce so rapidly as to produce complete insomnia, and would allow a re-increase of dose when neuralgias, migraine, etc., appear. In the second stage, that of complete dishabituation, cocain is an important help, and stimulants are to be used. After discharge the patient is not to be denied the therapeutic use of morphine, on condition, however, that he never administer it himself. The moral treatment must be prolonged after the physical treatment, and the patient shielded from nervous strain and overwork till returned to complete moral vigor. Dr. Schmidt asserts experience in support of his plan, though he does not give specific cases.

Die Selbstheilung der Morphiumsucht. "PROFESSOR CAROLUS." Berlin, 1889, pp. 15.

This pamphlet is the work of a musician who succeeded in breaking up his own morphine habit, and writes to encourage and point the way for others. His method is the simple one of gradual reduction of the dose, with regular weekly or fortnightly abstinences (which he considers of cardinal importance), carried out each time till the consequences become unbearable, and then relieved by a greatly reduced dose. The cure should be carried out with reports of progress from time to time to the family physician or some other, whose services will eventually be needed. A number of points of helpful physical and moral regimen are also mentioned. Such a cure would be well enough for those with determination enough to carry it out; the great difficulty, however, is that many have not the determination.

Morphinism. Dr. C. F. BARBER. Quarterly Journal of Inebriety, April, 1889.

The author discusses briefly the effect of morphine, and states his belief in the gradual reduction treatment, together with some particulars as to his method of procedure.

Ueber die Geistesstörungen des Senium. Prof. FÜRSTNER. Archiv f. Psychiatrie, Bd. XX, H. 2.

The basis of this study is furnished by 95 cases, all over 50 years of age, selected from a much larger number as distinctly senile. Hereditary predisposition could be traced in only 20 per cent, and rather as affecting the brain by way of the circulation than directly. The immediate occasion of the trouble may be change of long estab-

lished habits of work, removal from familiar and congenial circumstances, bodily disease, failure of the special senses, inebriety developed late in life, etc. The following table classifies the cases by forms of alienation:

Form of alienation.	No. of cases.	Cures.	Betterments.	Deaths.
Melancholia simplex	33	11	7	3
Melancholia agitata	18	5	2	4
Melancholia stupida	3	..	..	..
Mania	9	3	2	..
Paranoia (*Verrücktheit*) in more or less abortive form	7	3	..	..
Delirium (*Verworrenheit*)	11	6	1	2
Dementia senilis	5	..	..	..
Dementia, with organic brain changes	9	..	..	..

For the full description of these as influenced by age, the original must be consulted. It may be said in general, however, that the melancholias are almost always tinged with hypochondria. Simple melancholia is less deep and shows a tendency to remission. On the side of the will there is great weakness, with abrupt conclusions and violent acts. Suicide is attempted on insignificant occasion and without the customary warning in intensified depression. The movements in *melancholia agitata* are more unceasing than in younger patients. Mania was never in these cases free of intellectual defects, which showed themselves in a less copious flux of ideas, and in greater carelessness of consequences in action. Illusions, especially of hearing, are frequent, and their growth from simple subjective noises can often be followed. Their elaboration is generally incomplete, and never, in Fürstner's experience, reaches paranoia; the excitement and tendency to violence are also less. An important and apparently little considered form is a delirium with hallucinations. Atheromatous processes are important in its causation; the patients are persons that have led active and exciting lives with many excesses; there are prodromal headaches and oppression, light attacks of dizziness, constipation, icterus, insomnia, a lachrymose mood, irritability, failure of memory. Unlike other senile insanities, the disease begins in an acute attack, with extreme excitement, or after a spell of unconsciousness, and goes on rapidly to complete confusion and disorientation. In the production of these, illusions and hallucinations play an important rôle. The mood varies, but is generally depressive or anxious. There is compulsion to movement both purposeful and erratic, but less than in the *halluci-natorische Verworrenheit*, which it resembles in this initial stage. There are marked disturbances of circulation, and often of digestion, and cerebral symptoms that sometimes suggest meningitis, but these are transient. After this first period, which may last for weeks or months, a part of the cases slowly recover, others continue much longer, though without the motor feature; the chances of recovery are greater than in *melancholia agitata*. Its connection with the circulatory system is further shown by the beneficent effects of digitalis. General paralysis Fürstner considers doubtful after 60 years, and he has not found the associated disease of the cord which more and more appears to be a feature of that disease. In senile dementia the moral ideas seem of little stability; intellectual symptoms are generally not found pure, but appear combined or alternating with melancholia and mania.

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Insanity following Surgical Operations. C. T. DENT. Journal of Mental Science, April, 1889.

A surgical operation may disturb the mind by anticipation; by the pain, the relief or the shock of the actual operation; and by its after effects, the letting down of the mental tension, or the absence of a physical part that has been the center of over-subjectivity. It is to attacks of insanity which follow the operation, after a short period of normal mentality, that Dr. Dent devotes the bulk of his paper. He reports a number of cases, several from his own practice, but without attempting to trace the origin of the trouble on its psychic side. In a majority of the cases no tendency to insanity, personal or hereditary, could be found, and yet acute and chronic mania followed in some, and melancholia and dementia in others. The interval of sanity distinguishes such cases from those where the disturbances are due to the anaesthetic; and the trouble is not to be traced to a special antiseptic material, for the same was not always used. The author believes that these cases are rather overlooked than rare, and writes to encourage their observation.

Ueber die Auslösung von Schmerzempfindung durch Summation sich zeitlich folgender sensibler Erregungen. Ein Beitrag zur Physiologie des Schmerzes. NAUNYN. Archiv f. experim. Pathol. u. Pharmakol., Bd. XXV, H. 3-4.

Somewhat in continuation of earlier studies on disturbances of sensibility in tabes, the author now reports experiments on a peculiar kind of hyperaesthesia in certain cases, mostly of tabes, in which the summation of stimuli, individually painless, produced pain. The stimuli, 60–600 a minute, were induction shocks or touches with a needle, blunt wire, or fine hair-pencil. Successful application was generally limited to areas on the sole and top of the foot, which were inconstant as to position, and sometimes wholly disappeared. The cases fall into two groups. In one the pain entered somewhat abruptly after from 3 to 45 secs., rose to a maximum, and after a few seconds ceased, whether the stimulation ceased or not; occasionally it returned after a period equal to the first delay. The pain was generally located at the point of stimulation, but sometimes extended over one leg or even both. It was accompanied also in many cases by reflex movements of the skin. Single rather severe needle-pricks produced the same kind of pain (in both cases disproportionate to the stimulus) after a delay of 2–4 secs. In the second group the pain did not cease while the stimulation continued, reached its maximum more slowly, and the reflexes were less marked. There was here less delay in the pain produced by single stimuli than before, and sometimes none at all. In a single case of transverse disease of the cord the pain was frequently felt on the other side at the point symmetrical to that stimulated. For the details of the experiments and the variations of result with individual subjects, as also for a full clinical description of the cases, the original must be consulted. The most important general result was that the length of the delay in the entrance of the summation pain depended far more on the rapidity than on the kind or intensity of the stimuli. The same was found by Stirling and by Ward for reflexes, and other points of similarity are traced by the author. Pain of the kind in question, and perhaps all pain, he holds, depends

on summation, like the reflexes. Things that cause pain in common life are such as might well cause the nerve fibers to convey prolonged stimulation to the centers. The physiology of sensation may be conceived thus: Moderate stimuli are received by the end-organs, and the excitations are conveyed in the ordinary sensory tracts (probably the posterior columns of the cord) and do not summate. These tracts are, however, unfitted and inadequate for the excitations that result in pain (stimuli attacking the nerve-fiber itself directly or indirectly), and they are obliged to take others, probably in the gray matter of the cord, where they suffer summation and consequent delay, and cause pain. When the ordinary sensory tracts are useless from disease, moderate sensations are forced to take these other tracts, and so can also summate and cause pain, as in the cases experimented upon. If the gray matter itself were much affected, as in syringomyelia, this could not happen.

Ueber Wortneubildung bei Geisteskranken. Dr. BARTELS. 22. Vers. d. Vereins d. Irrenärzte Niedersachsens u. Westfalens. Allg. Zeitschr. f. Psychiatrie, Bd. XLV, H. 5-6.

An interesting detail in some cases of insanity, especially of long-standing paranoia, is the coining of new words. Besides simple misapplication of real words, there are some that are evidently made from words of similar sound, and still others to whose meaning there is no clue. There may be difficulty in finding out the signification of these from the patient, because he is offended at being asked to explain what he is sure are common and proper designations, or because of his suspiciousness. Four cases are given by Bartels, and in three there is abundant illustration of the new words used. One case did not know what some of the strange words meant, had perhaps heard them some time; another said they were revealed to her; a male patient, that they were given or brought to him, or arose through telephonic connections. From these explanations the author concludes that they originated in auditory hallucinations.

Hallucinations, and the Subjective Sensations of the Sane. D. HACK TUKE, M. D. Brain, Jan., 1889.

What is the seat of hallucinations? Is it peripheral, as Brewster thought? or central, as Esquirol believed? or is it the optic thalamus, as Ritti would have it? The author shows that none of these theories fits all the cases; there are hallucinations of peripheral origin, and as certainly of central origin, and, as against Ritti, of cortical origin. He discusses those of sight, and gives a number of interesting cases of his own observation, some sane and some insane, whose hallucinations he has been able to study more or less carefully. From a collation of these he arrives at some general means of distinguishing their seat, in substance as follows. Pressing the eye-ball to one side doubles only such things as are external to the eye, and so distinguishes real objects from hallucinations. Déspine, on the contrary, reports an insane patient with an hallucination of the Virgin that could be doubled. This the author does not try to explain, but leaves it as a counter case to those of his own observation. One of his cases, as one of Ball's and the subjects of hypnotic hallucinations secured by Binet and Féré, he regards as a case of illusion; and illusions, having a kernel of reality, behave like real

objects. An after-image on the retina may obscure real objects, moves with the eye, and is projected. If these characteristics are found in an hallucination it involves the retina. Those that do not may occur when the patient is blind and the optic nerves atrophied. The interesting phenomena of the projection of dream images, unilateral hallucinations and those produced by drugs, are touched upon. From suitable experiments with the last, thinks Dr. Tuke, something may yet be learned in regard to their seats, though the results so far have been anything but definite.

Ueber subjective Gehörswahrnehmungen und deren Behandlung. Dr. EICHBAUM. Berlin u. Neuwied, 1888. Heuser's Verlag, pp. 32.

The subjective sounds are here treated from the standpoint of the aurist. Those that are really pathological may arise from disease anywhere in the auditory apparatus from the periphery to the cortical centers. Those of origin in the sound-transmitting apparatus are most common, and almost all of them come from too great pressure on the labyrinthic fluid, in an hyperaesthesic condition of the nerve. Those from disease of the outer ear (rare) and of the drum are not apt to be strong or continuous, but some of those from the middle ear (more frequent) become so. Others come from trouble in the labyrinth itself. These are generally loud and accompanied by the symptoms of Mèniére's disease. Some arise from focal and general diseases of the brain or auditory nerve, and yet others from drugs and from general states of nervous disturbance, as hysteria and neurasthenia. The author also takes up prognosis and treatment. Here and there in the pamphlet are items of more direct psychological interest, for example, the remark that a man's business is apt to fix the character of the subjective sounds he hears (metal workers hearing hammering, musicians tones, etc.), and that the apparent intensity of the sounds may vary with the time of day and the mood of the patient.

In the *Annal. univers. di Medic. e di Chirurg.*, Vol. 285, April, 1888, Prof. Raggi describes two cases of unilateral hallucination. One was that of an alcoholic man, with delusions of persecution and bilateral hallucinations of sight. His unilateral hallucinations were of hearing and on the left side—noises, and voices defaming and accusing his wife. As these were only heard on that side, he concluded that she had tried to kill him by pouring poison into that ear. The continuous noises would point to peripheral excitation, but no disease could be found. The second case was that of a perfectly sane woman of 70 (earlier in life "nervous" and syphilitic), who for 15 years had had subjective sensations of sight. For about 5 years these were flashes and momentary red glimmers before the left eye. They then appeared before the right eye, at the same time gradually decreasing and finally disappearing from the left, where a cataract was forming. Two years later the cataract was operated upon and the lights returned. They likewise disappeared from the right eye on the formation of a cataract there. Later still the left eye was blinded by chorioiditis, without destroying the sensations, which on the contrary developed at last into hallucinations of landscapes, palaces, persons, animals, etc., all still confined to the left side. In this case a peripheral disturbance probably gave

rise to central hallucinations. Such a peripheral origin seems common. Prof. Raggi has gathered 15 cases of unilateral hallucination from the literature; 9 were of hearing, 6 of sight; the left side was affected 11 times, the right 4, thus falling in with the view that makes the left half of the body predominantly sensory, the right predominantly motor.

IV.—MISCELLANEOUS.

The Double Brain. H. MAUDSLEY, M. D. Mind, April, 1889.

How the two hemispheres co-operate for the work of one mind is a question the answer to which must at present partake of speculation. Maudsley's answer, though something less than demonstrative, recommends itself at a number of points. In a discussion of the motor functions of the hemispheres he shows that, like the eyes, they have a large field of action in common, but also partial fields not in common. The same may be assumed of their sensory functions. Their relatively greater independence as centers of consciousness does not wholly destroy their unity of function. That rests upon the unity of feeling and action, and these in turn on the unity of the organic life of the single body. The brain is not a superadded regulator of the body, but part and parcel of it and its representative. The hemispheres act together, however, only when they have been trained to act together, as the eyes learn by experience to unite their double images. One hemisphere may, perhaps, control what has become automatic, but both probably co-operate for close attention and for the best apperception. Loss of the unifying power and improper action of the hemispheres makes mental disturbance. Mania and melancholia may be conceived as resulting respectively from an elevation and depression of the unifying power, the "disintegration of the ego" attending epileptic attacks from its perversion. For abundant illustration of the theory in the case of abdominal wounds, dreams, the powers of erratic geniuses, etc., the original should be consulted.

Muscular Movements in Man and their Evolution in the Infant . . . . together with inferences as to the properties of the nerve-centers and their modes of action in expressing thought. FRANCIS WARNER, M. D. Journal of Mental Science, April, 1889.

The emphasis laid by modern psychology on the motor side of mind makes such studies as those of Dr. Warner important. The first of the three sections of his article presents the relations of movements as to time, quantity, antecedents, delay, reinforcements, sequence, etc., gives something of the movements of different bodily parts, and shows the connection of movements with the nervous system. In illustration, fatigue and sleep are described in motor terms. The second section deals with the development of motion. At first there are certain reflexes and respiration. When the child is awake there are also more or less constant irregular movements, especially of the smaller members. These spontaneous movements the author calls microkinesis. They are not at first influenced by stimuli to sight and hearing, though the reflexes respond to touch. Reinforced action appears in the child's crying. In the following weeks the movements gain in force and extent, and new ones appear. At four months the

DO NO

child is affected by stimuli of sight and hearing; the microkinesis is temporarily inhibited by them (finely shown in graphic tracings), and a little later such inhibition is followed by general movements of response. There is evidence of retention, but no delay in the responses. At three years the control of the senses is very much widened; delayed and compound responses and those disproportionate to the stimuli are frequent; there is also imitation—all showing increased complication and interaction in the centers. At ten there is little microkinesis, and the responses to sensations are yet more delicate and varied. In the third section the author draws his conclusions as to the cerebral side of this evolution. The most important of these are connected with what he terms the diatactic action of the nerve cells, that is, their preparation for combined action. This diatactic action takes place in periods of inhibition, and is shown by the complicated motions which follow. Thought, which can be known only by motion of some kind, is the correlate of this diatactic action. The discharge of the functionally united cells need not, however, be directly into the muscles, but may spend itself in forming other unions. Motions of intelligence differ from others in their better adaptation. The cerebral qualities that favor such motions are given as follows: "1. Action in many small parts, not necessarily directly stimulated by any present or immediate antecedent forces. 2. Retentiveness and capacity for delayed expression upon a subsequent stimulation. 3. Capacity for the formation of functional unions among cells upon slight stimulation, such unions sending efferent currents to certain centers or muscles, with exactness, upon their stimulation."

Untersuchungen über den Musiksinn der Idioten. Dr. WILDERMUTH. Jahressitzung des Vereins der deutschen Irrenärzte, 1888. Allg. Zeitschr. f. Psychiatrie, Bd. XLV, H. 5–6.

The musical sense of idiots has attracted notice, but seems never before to have been specially investigated. The author has examined 180 of that class, and for comparison, 82 children from 7 to 13 years old. The less defective portion of the idiots were tested for compass of voice, certainty in giving a note, ability to distinguish the tones of a chord, musical memory, etc. They were marked on these tests by a credit system, and divided into four grades. The percentage of the whole number in each grade was as follows:

	Grade I.	Grade II.	Grade III.	Grade IV.
Idiots.....	27 (16)	36 (29)	26 (36)	11 (19)
Children.....	60	27	11	2

The percentages in parentheses are for a certain number selected from the full list whose mental state was that of children 2–4 years old, and who were in general considered incapable of education. Considering that the children had had a good deal of training and the idiots little, and that the investigation was made difficult by the general helplessness of the latter, and, in the case of many, by their lack of concentration, the showing is relatively as well as absolutely good. Female subjects, both normal and abnormal, were the more talented. In rhythm no errors were made, except by three idiots. With the still more defective portion of the idiots (30 cases) simpler tests had to be used (noises, a metronome, music-box, etc.), and the effect judged from aspect and gesture. Five failed to respond.

Most did not show displeasure at sounds unpleasant to the normal ear, while many did show antipathy to certain tones or noises not commonly unpleasant. The rhythm of the metronome pleased about one-third of them, and all found the music-box agreeable. The ways of expressing pleasure were various, but always exactly the same in a given individual. The emotion reached its height in 5–20 seconds; after 2–5 minutes it gave way to rather sudden fatigue. If the music continued, another accession of emotion followed, after an interval of indifference, but all reaction failed after 15–20 minutes of continuous playing. Five could hum tunes and learn to hum new ones. In five cases of acquired motor aphasia, the musical sense, both active and passive, was injured or destroyed, while in three of congenital origin it persisted; of twelve that were aphasic from intellectual defect, only two failed to respond. The response of such defectives, especially as compared with that to other aesthetic stimuli, testifies to the very fundamental nature of rhythm and music.

On Alternating Sounds. Dr. F. Boas. Amer. Anthropologist, Vol. II, p. 47, Jan. 1889.

"Alternating sounds" in language are such as may stand interchangeably the one for the other. A philologist in reducing a savage language to writing may at one time write *păc*, at another *bas* for the same word. These variations are due, as the author believes, not to real alternations of the sounds, but to alternations of apperception on the part of the hearer. In the same way he explains the mishearing of words attributed to "sound-blindness" (see experiments of Miss S. E. Wiltse, Amer. Jour. Psy. I, 702). The philologist on hearing a sound that falls between two familiar ones apperceives it first as one and then as the other, or he may hear sounds really different as one and the same. In the "sound-blindness" experiments the mishearing is not entirely at random; but the sensation of some letter-sound or word, varying slightly for some reason from the usual one, is heard as some other sound or word known to exist in the language

Un nouveau cas de guérison d'aveugle-né. Charles Dunan. Revue Philosophique, January, 1889.

A little girl, thirteen years old, was successfully operated upon for congenital cataract in the right eye, the left being hopelessly lost. Her previous seeing had been limited to distinguishing day and night. Two days after the operation the bandages were removed and a few tests made by the surgeon. Eight days later she was seen by Dunan and other tests made. Her perception of depth in space (monocular, of course) was very imperfect. She did not, however, perceive objects as in her eye or touching it, but saw them projected apparently at an indeterminate distance. Her perception of form, size, and direction was good. She said a disk of paper was round and white (she had seen some round objects and been taught the colors since the operation); she told which was the larger of two rectangles of paper; she reached in the right direction to grasp objects. The author goes to some trouble to prove that her condition was practically unchanged from the first, a thing which it is hardly necessary to say does not take the place of proper experi-

ments at the removal of the bandages. The last part of the paper is given to a discussion of nativism and empiricism from the standpoint of the psychic synthesis theory.

Eine Beobachtung von Autohypnose. A. FOREL. Münchener med. Wochenschrift, No. 3, 1889.

Prof. Forel describes a not infrequent experience of his own, the original notes of which, in this instance, were made in 1878. He is sleeping in his easy chair against his will, his head on his right hand and his elbow on the arm of the chair. He struggles to wake up, succeeds in moving his left arm a little, and repeats the motion, but cannot increase it. Another effort lets him half-open his eyes, and he can see that his arm actually moves. He cannot move his body, but by and by is able to raise his head a little. It drops back, and his arm having moved a little forward, his eye is brought against the lower joint of his thumb. This is repeated seven or eight times, while he makes desperate and resultless efforts to get his hand under his head again. At last, however, he secures command of his body, and then of his legs, and takes pains to wake himself beyond peradventure. His sense of hearing is awake at such times, but liable, like the muscle-sense, to dream deceptions. The state is not a sleep condition of special muscle groups, but of special coordinated movements. Prof. Forel at present considers that at such a time he is auto-hypnotized, and that the auto-suggestion of motor inhibition grows in strength as his repeated and unavailing efforts convince him of its power.

Dreams, Sleep, and Consciousness. GEO. M. GOULD, M. D. Reprint from "The Open Court" of January 24 and 31, 1889.

This article is speculative, not to say fanciful. When the author announces his intention "to study the nature of consciousness and of its origin, from the facts of sleep and dreams," and presently takes up the question of "What is Consciousness?" the non-speculative psychologist may be excused for hesitation. The article, however, contains suggestive points, not the least valuable being the author's remarks upon his own dreams, etc.; for example, that in which he describes the experience of being consciously awake and yet struggling to rouse the somnolent motor centers—apparently the same as that described by Prof. Forel above. Cases of this kind are, perhaps, not extremely rare; a third has been personally reported to the writer of this note.

The Moods of the Sane. A posthumous paper by J. MILNER FOTHERGILL. Alienist and Neurologist, April, 1889.

The author takes up in a popular way, with entertaining anecdotes and citations from literature, the dependence of mind on body in normal and abnormal states of the latter; for example, the relations of courage and diet, the dullness of the anaemic brain, the characteristic moods of dyspepsia, consumption, cancer, etc. At no point is the influence of body more striking than in these all-pervasive changes of emotional tone.

Economy in Intellectual Work. Wm. H. Burnham. Scribner's Magazine, March, 1889.

This is an attempt to outline the principles that underlie economic mental activity. The relation of unconscious cerebral processes to the problem of economy is especially considered. Adopting the theory that bases attention upon emotion, the writer urges that an emotional stimulus is necessary for economical mental work, and concludes that emotional dissipation in childhood and at adolescence is likely to leave the mind barren of healthy interests and without emotional support in its intellectual activity.

Sonnenschein's Cyclopaedia of Education. Edited by Alfred Ewen Fletcher. Syracuse: C. W. Bardeen. London: Swan Sonnenschein & Co. 1889.

Among the contributors to this convenient hand-book are Oscar Browning, Sir Philip Magnus, James Sully and other eminent educators. It covers a wide field, containing not only articles relating to the history, theory, and practice of education, biographical sketches, explanations of pedagogical technicalities, and the like, but also articles upon the mental activities, the sentiments, virtues, and other psychological and ethical topics. In the psychological articles the attempt is made to show the pedagogical aspect of the subjects treated. Although its psychological horizon is necessarily limited, the book is a valuable addition to educational literature. An excellent bibliography of thirty-four octavo pages is appended.

W. H. B.

Memory as a Power of Knowledge. Wm. L. Evans, M. A. New York, 1888.

This book outlines the psychology of memory and the association of ideas, and contains a mnemonic system based on the principles of the Pick-"Loisette" method. The author adopts a figure alphabet, connects dissimilar words by "intermediates," and gives mnemonic series of words for practice. One of the best features of his psychopedagogical discussion is the emphasis placed upon the training of the attention. It may, however, be doubted if the author's method of effecting this training —*i. e.* by the treadmill recitation of mnemonic series—is altogether the best one.

Report of the Committee on Phantasms and Presentiments. Josiah Royce. Proc. Amer. Soc. for Psychical Research, Vol. I, No. 4, March, 1889.

This report is the most important and most extensive of those in this number of the *Proceedings.* The material upon which it is based consists, so far as published, of between 70 and 80 cases, of which 33 are considered in the body of the article. These are classified and treated under the following headings: I. Subjective Hallucinations of Familiar Type; II. Instances of Recognized Sorts of Unconscious Cerebration; III. Pseudo-Presentiments, and, IV. Coincidences. The most important feature of the report is the theory of Pseudo-Presentiments, advanced in the third section. In a word, it is that normal persons are occasionally subject to a trick of memory something like that which gives one in a

new place the feeling, "I have been here before," but which in this case takes the form, "I have already dreamed this, or had a presentiment of it, or it has been prophesied to me." Outside of dreams, where the experience is not infrequent with some people, it is difficult to get perfectly clear cases, for it can rarely be proved absolutely that the person reporting such a coincidence has not happened to have such a dream or presentiment before the event in question. The explanation is, however, extremely plausible, has indirect evidence, and a very extensive explaining power. Under the fourth heading Prof. Royce gives a few cases in which a thought, dream, or presentiment of one person coincided more or less closely with an experience of some other person. Of these cases, 3 are supported by documentary evidence, 4 by strong testimony without documents, and 5 are of less certainty.

NOTES.

Exner and Paneth (*Pflüger's Archiv*, XL, p. 544), repeating the experiments of Marique, found that when those parts of the brain of the dog which contain the motor cortical fields for the extremities are cut around, so as to sever their association-fibers but not their projection-fibers, care being taken to injure as little as possible the blood-vessels of the pia mater, the dog showed all the symptoms which follow complete extirpation of the same part. The authors attribute the atrophy which sets in, in part to disturbances of nutrition, and in part to the separation of the association-fibers. As in the case of extirpation, nearly complete recovery of function takes place after a few weeks or months.

The paralytic brains among those of 453 East-Prussian insane studied by Dr. Julius Jensen (*Archiv f. Psychiatrie*, Bd. XX, H. 1), showed a deficiency in weight of about 20 grams for each year of disease. The atrophy, as indicated by the weight of the separate parts (divided according to Meynert's method), seems to spread over the mantle from in front; the axial portions are also much affected. In melancholia the frontal portions are not affected, though the mantle as a whole is light. The normal proportion of the mantle in 1000 parts is 785.82, in melancholiac men 780.01, in melancholiac women 779.31. Taken altogether the figures show the right half of the brain heavier than the left.

Dr. Tigges has studied in the same way the brain weights of 123 insane men and 127 insane women in Sachsenberg (*Zeitschr. f. Psychiatrie*, Bd. XLV, H. 1–2). The average weight with membranes was respectively 1362.3 and 1243.6 grams, the variation of the individuals from the mean being greater with the insane than the sane. The averages for different forms of alienation for the men were: mania, 1430.7; melancholia, 1392.8; primary forms in general, 1402.3; secondary forms in general, 1401.3; simple psychoses, 1401.7; paralysis, 1283.7; epilepsy, 1362.3; in the last there was con-

siderable variation. For the women the weight after melancholia was higher than after mania, and the difference between primary and secondary forms greater. The brains of female epileptics were relatively heavier than those of the males, and of female paralytics, lighter. Rather heavy brains were found after periodic insanity; men, 1400.3; women, 1347.5. Taken separately, the brain mantle was a little heavier in proportion to the whole in the men; the cerebellum and axial portion a little heavier in the women. The mantle is relatively light in the insane, the remainder of the brain heavy. Most of the male brains were heavy in the tempero-occipital and parietal regions, the female in the frontal, but there were not a few exceptions. Tigges, like Jensen, found the frontal portion heavy after melancholia, very light after paralysis; heavy also in delusional insanity and light in mania—suggestive facts, in his opinion, in view of some features of these troubles. In epilepsy the proportions are irregular. The right hemisphere in the insane was found, as above, heavier than the left, and more so than in the sane; the frontal portion was always heavier on the right, and the parietal and tempero-occipital on the left, except in primary psychoses. The difference of the hemispheres was greatest in idiocy, epilepsy and paralysis, where also the left was frequently the heavier. The period of greatest weight for the male was from 30 to 80 years, for the female 40 to 70. The weight of the brain increased with the length of the body, faster in women than men, though the weight as compared with the length was greater in men. From a comparison of his results with those of others Tigges is inclined to believe in different average weights for the different German populations.

After two years' experiments as to the optical disturbances following lesions of the cortex in monkeys and dogs, Lannegrace has arrived at a set of results quite at variance with those now accepted (vide *Archives de méd. expériment. et d'anat. pathologique*, Jan., 1889). Instead of finding such disturbances only after injury to the occipital region and adjacent parts, he finds hemiopia after injuries in almost any part of the cortex (the occipital region being an important but not an exclusive center), and crossed amblyopia after injuries to a limited area in the parietal and frontal regions. Lannegrace himself notes the difficulties of determining the exact nature of the visual effects produced and the frequency with which the experimenter is obliged to depend on general impressions. In these, perhaps, lies the secret of the differences.

H. J. Hamburger (*Feestbundel van Donders*, 1888) experimented on the time necessary to produce a perceptible change in the color of the visual purple in the eyes of frogs. For the different parts of the spectrum, the time required was, in hours,

C	D	E to b	b½ to F	F
40	20½	7½	10½	14

And when the width of the slit was made inversely proportional to these times, then lights of all wave-lengths produced a just perceptible change in seven and one-half hours.

When one looks with the head inclined to one side at a bright vertical line in the dark, the line appears inclined to the opposite side. This phenomenon, discovered by Aubert, has been explained

by him and by Helmholtz as due to an under-estimation of the deviation of the head, the rolling of the eyes under such circumstances being insufficient to account for it. M. E. Mulder, who has recently given attention to the subject (*Feestbundel van Donders*, 1888, p. 340), though in doubt as to the true explanation, thinks this one at least insufficient. He finds that even when the head is known to be horizontal, the illusion amounts to 20° or 30°. It does not vary in accord with the errors made in estimating the position of the body when inclined to one side or the other in a movable box. If the eyes are closed for an instant and then opened, it is at first less, but presently regains its former amount. It varies with the individual from 10° to 60°, and with the inclination of the head. It persists in spite of practice.

In an inaugural dissertation, *Ueber die Messung der Tonstärke* (Berlin, 1888), M. Wien has described a new phonometer and a series of interesting experiments executed with it. Applied to the testing of Weber's law, the apparatus gave with a tone of 440 vibrations the following values for the discriminative sensibility:

Intensity.	Discrim. Sens.	Intensity.	Discrim. Sens.
Circa 1.6	(Threshold)	Circa 10^6	.140
5	.135	10^7	.153
20	.108	10^8	.161
10^2	.112	10^9	.178
10^3	.118	10^{10}	.225
10^4	.116	10^{11}	.350
10^5	.131		

The discriminative sensibility is thus finer for tone than for noise (that usually measured); it is finest for an intensity about ten times the threshold value; and gradually becomes blunter as the intensity increases. Weber's law holds approximately for a part of the series. The power of discrimination was found to be strongly affected by the pitch of the tone. The absolute changes of pressure at the threshold are given at 0.59 $\mu\mu$ of mercury, and the amplitude of the vibrations of the air particles at 0.066 $\mu\mu$ ($\mu\mu$ being one millionth of a mm.), a value about one-seventh that given by Lord Rayleigh. The energy at the threshold is estimated at about six times that for sight (e. g. seeing a star of the sixth or seventh magnitude). The intensity of the first over-tone in the vowels, when the fundamental was represented by from 15 to 20, was about as follows: a 7, e 11, i 12.5, o 25, u 3.5, ü 5, and ä 10. In large open spaces the intensity of a tone decreased in close approximation to the increase of the square of the distance.

The following explanation of the function of the arches of Corti is given by Dr. C. Brückner in *Virchow's Archiv*, Bd. CXIV, H. 2. The physicists have shown that the tone of a vibrating rod, fixed at the middle, descends as the ends are bent around into the shape of a tuning-fork. Brückner himself got a somewhat similar result from rods fixed at the ends. Now the Corti arches at the base of the cochlea are small and little spread, those at the upper end large and much spread. The size and shape therefore work at cross-purposes, approximately compensate each other, and bring it about that all the arches can vibrate to each of the strings of the basilar membrane, like the sounding-board to the different strings of a piano.

In the same paper the author records an observation in support of the separateness of the organs for hearing noises and tones, which, though it is far from decisive, has been frequently made by him, and is not without interest. On waking during the striking of a clock, he hears first a continuous musical tone, and only at the last the noise of the single hammer-strokes—in his opinion, because the tonal organ awakes first.

In a recent article on Ataxy and Muscle-sense (*Zeitschr. f. klin. Medicin*, XV, 1–2; cf. abstract of an earlier communication, this JOURNAL, Vol. I, p. 324), Goldscheider has undertaken an investigation of the senses that mediate muscular co-ordination. He treats the subject under these heads: (1) feeling of passive and (2) active movements, (3) the perception of position, and (4) the sensation of weight and resistance. (1) A passive bending of the finger (at the second joint from the end) is perceived when it has reached 0.60–1.74°, and the perception is due, not to the slight sensation of pressure caused in moving the finger, but to sensation in the region of the joint; for, when the first is in a measure destroyed by faradizing the last phalanx, the perception of motion is practically the same, but when the joint is faradized the perception is much less acute. Indeed, when the electric stimulation is not applied, careful observation can distinguish one sensation from the other. That the sensation is chiefly in the joint and not in the skin about it is shown by the fact that when the skin was made insensible by faradizing, a motion of 3.14° could yet be perceived. The rapidity of motion is also of influence. (2) The results are the same in general for active motion, sensations in the tendons (which are here more important than in passive motions) perhaps accounting for the somewhat finer perceptions. The author is inclined to exclude muscle-sensations proper, because on tetanizing a muscle they do not appear till the contraction is much greater than the amount in question. The beginning of a motion does not require muscle-sensations, and when it is once begun the various sensations accompanying motion make it unnecessary. He would not, however, deny their existence in certain muscles of the eye and others not producing motion in a joint. He found also that while an idea of motion could be voluntarily called up without actual motion, the idea of the sensation of motion could not be. (3) The sense of position comes from the tendons and their connections and from the skin; and the author does not believe that the sensation of motion is derived from that of changing position, but considers it an independent and primary sensation. (4) He holds the sensation of weight as also peripheral. These sensations give the data for muscular co-ordination; ataxy is a result of their more or less complete absence. Bendings and straightenings of the faradized finger intended to be of a certain extent and rate were found to be irregular, too great, and too rapid. A greater motion is necessary under such circumstances to give a sensation equal to that experienced in the normal finger. The irregularities, the extent and the rate were increased by attention to the motion, but decreased when it was followed with the eye. The ataxic gait the author attributes to a decline of the sensations of movement in the knee and hip joints and of the sensations of tension in the tendons. This hinders co-ordination of antagonistic muscles; and with it probably co-operates the lowering of muscle tonus.

The distinct forms of periodic insanity so far recognized Professor Mendel would gather under the three heads of mania periodica, melancholia periodica, and delirium hallucinatorium periodicum. To these he would add paranoia periodica, and describes three cases in which the typical hallucinations and delusions of persecution and grandeur were present in periodic attacks. There was no delirium; one of the cases, a merchant, was able to attend to his business. A fourth case is also added, that of a man who, after nine periodic attacks of melancholia, had one of mania with initial melancholia, then one of melancholia with illusions and delusions, and finally a twelfth of full paranoia. (*Allg. Ztschr. f. Psychiatrie*, 1888, Bd. XLIV, H. 6.)

An interesting case of *folie à deux* is reported by Dr. M. J. Nolan in the *Journal of Mental Science* for April, 1889. The patients were brothers, both weak-minded, the younger infected by the older, he by his mother, and she by her husband. The two sons had lived together in almost complete seclusion, taking care of their mother, bed-ridden for seven years. The resulting similarity of mind was very great. After three months of separation at the asylum, they simultaneously announced the same delusion, agreeing even in details, and on another occasion dreamed the same night at nearly the same time of seeing their mother. The author takes the case as evidence that the identical ideas in this disease are not always communicated.

In the *Journal of Mental Science* for April, 1889, John Baker, M. B., discusses the incendiarism of the insane, chiefly on the basis of cases from the Broadmoor Asylum. From 1864 to 1886, 95 men and 8 women, respectively 7.5 and 2 per cent of the total commitments, were received for arson. Continental experience gives a larger proportion of women, many being servant-girls between 12 and 18 years old. The distribution among the forms of insanity was as follows: congenital imbecility 36, melancholia 21, congenital epilepsy 4, general paralysis 6, acute mania (usually *à potu*) 6, recurrent mania 4, chronic mania 7, monomania 9, dementia 10. While admitting a connection between insanity and a propensity for fire-setting, the author concurs in the generally accepted opinion against an instinctive "pyromania," and in favor of a more frequent connection with the reasoning forms of insanity.

In the brain and cord of dogs after acute intoxication with ethyl or amyl alcohol, W. Tschysch finds no histological changes; but regularly after chronic intoxication, puntiform hemorrhages, especially in the gray matter of the cord, together with exudation of plasma, degeneration and destruction of the nerve-cells, chiefly in the neighborhood of the vessels. The kind of lesion is the same with either alcohol, but the amylic is fatal in smaller doses. (Report of Proceedings of III Congress of Russian Physicians, 1889, *Neurolog. Centralbl.*, No. 7, 1889, p. 209.)

A case of etheromania is reported by Ritti in the *Annales médico-psychologiques*, Jan., 1888. The victim was a woman of about 40, well educated, but of unfortunate heredity. At 22 ether had been prescribed for gastralgia and weakness, and she had become dependent

upon it, but had been able to break off. When prescribed at this later period for similar troubles attending metrorrhagia, she was not able to break off and came to use more than 200 g. a day. As her means failed she was reduced to street-begging to procure the intoxicant, and was found in public places stupefied from inhaling it. She was arrested and pronounced insane. Under compulsory abstinence she recovered in about six months, with one relapse. The effect of the ether was like morphine in giving the woman a liveliness and talkativeness quite different from her ordinary taciturnity, also in its abstinence phenomena, and the imperious nature of the craving it created.

Alcoholic paralysis has generally been considered a disease of the peripheral nerves, though degenerations have occasionally been found in the cord. Dr. Karl Schaffer observed in the cord of a female drunkard (*Neurolog. Centralbl.*, No. 6, 1889), who in life had been paralysed in the lower limbs, atrophy or sclerosis of the greater part of the cells in the anterior horns in the lumbar region, amyloid concretions diffusely scattered through the whole cord (thickest in the posterior columns), and apparent atrophy of single cells in the columns of Clarke. The anterior and posterior roots were normal, as were also the greater portion of the cells in the cervical region. The peripheral nerves could not be examined. Of nearly the same tenor were the findings in a case reported by Dr. A. Erlitzki to the Congress of Russian Physicians (reported in the *Neurolog. Centralbl.*, No. 7, p. 210). The very evident central effects of alcohol (drunkenness and psychic disturbances), with the degenerations in this and a similar case of Kahler and Pick's, lead Erlitzki to the opinion that the beginnings of alcoholic paralysis are in the cord.

To the happily small list of cases of delirium tremens in childhood, Dr. E. Cohn adds another case (*Berl. klin. Woch.*, No. 52, 1888). The patient was the five-year-old son of a saloon-keeper, who had been given, with all good intention, a glass of "Luft" (cummin brandy?) every day by his grandfather, some Hungarian wine by his mother, and had gotten besides more or less beer and sometimes an extra glass of "Luft." He was run over and brought to the hospital with a broken leg. The next day the delirium appeared accompanied by pronounced tremor, but with a dose of chloral hydrate was over in 24 hours. The leg healed well, the child in the meantime having had the measles. The close sequence of the delirium upon the injury and the withdrawal of alcohol, its short duration, and the tremor connected with it, are worthy of notice.

In a case of alexia of Dr. Brandenburg's (*v. Graefe's Archiv f. Ophthal.*, 1888, XXXIII, 3), the patient, while unable to read words, was able to read Arabic numerals. Dr. Brandenburg explains this exception somewhat as follows. When an uneducated man, like the patient, reads, it is necessary that the center of visual images, the center of auditory images of the letters (since he spells in reading like a child), and the center of speech-movement images should all be put in action, before the word that is read becomes an idea. With an educated man, on the contrary, the process is short-circuited and the word becomes an idea at once. This patient was in the latter state

as regards numerals; though the roundabout way was broken, the other direct way was still intact. There is, however, some reason to conjecture a distinct location for number images; at least Oppenheim mentions a case in which disease of the right hemisphere was accompanied by loss of them.

In the *Deutsches Archiv f. klin. Med.*, XLIII (1888), 4–5, Dr. A. Knoblauch reports the case of a girl six years old, suffering apparently from encephalitis, with right hemiplegia and aphasia, who, at a time when she was quite unable to speak voluntarily or at dictation, retained the power to sing the words of a familiar tune. Even if such speech is automatic and may be mediated by the right hemisphere, the mechanism of tracts and centers by which this is done is still to be discussed. Into this theoretical question the author goes with fullness, deducing from his schema the disturbances of the musical faculty, and naming them after the analogy of those of speech, *e. g.* "amusia," corresponding to motor aphasia, "paramusia" to paraphasia, "tone-deafness," "note-blindness," etc. Some of them he is able to parallel with symptoms from cases on record.

For the cerebral weakness corresponding to neurasthenia, Prof. Finkelnburg suggests the term *phrenasthenia* (Jahressitzung des Vereins der deutschen Irrenärzte: *Allg. Zeitschr. f. Psychiatrie*, Bd. XLV, H. 5–6). The characteristic of phrenasthenia, as of neurasthenia, is the ready exhaustibility of the patient, though this is obscured in the first by the fact that it may affect either the active functions or those of inhibition, and give rise to a torpid or an erethic form. In the discussion that followed, Professor Mendel confessed himself a heretic on the doctrine of neurasthenia, believing the name to cover a group of functional neuroses. In Finkelnburg's analysis of phrenasthenia he saw a return movement toward the scientific standpoint. As evidence of the near connection of neurasthenias with actual insanity, Dr. Knecht mentioned a case in which torpid asthenia, erethic asthenia, and good health alternated like the stages of depression, excitement, and the lucid interval in circular insanity.

Evidence accumulates that men, even those in virile occupations —blacksmiths and soldiers—may be subject to hysteria. At the Congress of Russian Physicians at St. Petersburg, January 3–10, 1889 (*Neurolog. Centralbl.*, No. 7, 1889, p. 209), Dr. Oseretzkowski made further reports of his studies in the Moscow Military Hospital. He has now records of 38 cases (33 privates, 5 officers) in which the disease appears in its protean forms of paralyses, contractures, convulsions, mutism, etc. The doctor deprecates the tendency to regard hysteria in soldiers as simulation. The case of a merchant thus affected was also reported in the session of February 23, 1889, of the Association of Physicians of Budapest (*ibid.* p. 216).

In the January number of *Brain*, Dr. Wiglesworth and Thos. H. Bickerton report further investigation of the relation of epilepsy to errors of ocular refraction. In 103 unselected insane and imbecile cases they found 48 in which there was noticeable error. The percentage among the imbecile was a little less than among the other insane, indicating, as far as a small number of cases may, that these anomalies are not to be charged to general degeneration. These

cases were not suited to the further step necessary to prove a causal dependency of epilepsy on errors of refraction, *i. e.* the cessation of the fits after correction of the errors, but in nine cases reported from private practice, all showing errors; some success was met. The authors do not, of course, regard the strain coming from these errors as more than an exciting cause to otherwise unstable nervous systems.

In spite of much investigation, the function of the thyroid gland and the manner in which the disturbances that often follow its removal are caused remain as yet uncertain. Th. Drobnick (*Archiv f. exp. Patholog.* XXV, p. 136), after operating upon 8 dogs, 3 of which survived, concludes that the gland is not essential to life, and that the disturbances of circulation and respiration, the convulsions, pareses, etc., that follow its extirpation, depend upon the excitation, directly or reflexly, of the neighboring nerves. The troubles are rather to be compared to tetanus than *cachexia strumipriva*. H. Schwartz, who has studied the relation of the sequelae to tetanus (*Inaug. dis.*, Dorpat, 1888) believes that they may be related in causation, but are not identical. Munk explains their genesis, in reporting further studies on the subject (*Sitzber. d. kgl. preuss. Akad. d. Wiss.* 1888, XL, p. 1059), as due to injury of the nerves lying near the gland; this causes disturbances of circulation and respiration, which in turn bring about mal-nutrition of the central nervous system, whence the convulsions, etc. To this points the fact among others that similar disturbances can be produced by injecting dilute croton oil into the region of the gland. To another experimenter (Rogowitch: *Archives de Physiol. norm. et patholog.* (4), II, p. 419), the results seem like those of a nerve poison, say of phosphorus. This poison, as he thinks, arises in normal processes and is counteracted by the gland. In this function the pituitary body can to a certain extent act vicariously. Clinical opinion as to the dependence of myxoedema on loss of the gland seems almost equally at variance (see a number of articles abstracted in the *Neurolog. Centralbl.* No. 5, 1889).

Dr. P. Grützner argues in the *Deutsch. med. Wochenschr.* 1889, No. 1, that the experiments of Munk and others, who have found no serious disturbances after removal of the thyroid gland, are inconclusive because there are frequently many little accessory glands widely scattered through the adjacent parts. In some fatal cases these have been found; in some cases of recovery also they have been present and enlarged. He believes on the whole that the disturbances cannot be explained by simple injury of the nerves, but that in addition a special toxic substance is developed, either in the wound or elsewhere in the body; and if the latter, the causal connection with the removal of the gland may be assumed.

In the February number of *Education*, Dr. C. F. Crehore gives a brief sketch of a system of anthropological measurements for use in schools. It includes both physical and mental measurements, and would, no doubt, lead to the collection of valuable information, though it might, perhaps, be improved. An adoption of the scheme used by Galton, or an addition of the points in which his differs, would give opportunity for most desirable combinations of data. The political economists have frequently found international comparisons impossible from such differences in the schemes by which their statistics are gathered.